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Studies of the Early Life History of Atlantic Menhaden in Estuarine Nurseries

Part I--Seasonal Occurrence of Juvenile Menhaden and Other Small Fishes in a Tributary Creek of Indian River, Delaware, 1957-58

by Anthony L. Pacheco and George C. Grant

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CONTENTS

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ABSTRACT

Monthly occurrences and size ranges of juvenile Atlantic menhaden and other small fishes in a tributary creek of Indian River, Del., are summarized from nearly 800 seine collections made over a 15-month period, 1957-58. Fish of 32 families, 48 genera, and 58 species were caught. Atlantic menhaden was the principal spring-fall migrant during this study. The resident fish group was principally composed of three cyprinodont and two atherinid species. Peak catches of migrants were made in March and September and of resident species in November. Summaries of seasonal availability and distribution of species, as well as notes on occurrence of the smallest specimen of each principal species, are included. Sampling problems and similarities of the fish fauna to those described in other estuaries along the Atlantic coast of the United States are discussed.

INTRODUCTION

The Atlantic menhaden (Brevoortia tyrannus) depends upon the estuarine environment for part of its life cycle (June and Chamberlin, 1959). Larvae and juveniles have been reported in nearly every river system along the Atlantic coast of the United States from Maine to Florida (DeSylva, Kalber, and Shuster, 1962; June and Chamberlin, 1959; Massmann, Ladd, and McCutcheon, 1952; Raney and Massmann, 1953; Scattergood, Trefethen, and Coffin, 1951; Sutherland, 1963).

The Bureau of Commercial Fisheries studied the early life history stages of this species in White Creek, a tributary of Indian River, Del., from April 1957 to June 1958. The purpose was to determine the biotic and abiotic factors that might affect the distribution, growth, behavior, survival, and abundance of larvae and juveniles within a single nursery area. Data collected included temperature, salinity, hydrogen ion concentration, phosphate concentration, dissolved oxygen, and plankton volume at eight locations (figure 1). Fishes also were collected.

This report summarizes data on the fish collections, including (1) a checklist of species and (2) their seasonal occurrence, distribution, and relative abundance. Comparative data from nearby localities (DeSylva, Kalber, and Shuster, 1962; Schwartz, 1961) are discussed.

DESCRIPTION OF THE CREEK AND SAMPLING LOCATIONS

White Creek (figure 1) flows northeasterly into Indian River Bay, the small, shallow estuary of Indian River. The surrounding terrain is generally low, nearly featureless, and typical of the middle Atlantic coastal plain. Most of the watershed is farm land, with corn and soybeans the principal field crops.

The creek shoreline is mostly in its natural state. Shores have not been extensively cut or filled, and only scattered residential development has occurred. Landward, the intertidal beach is fringed with the salt marsh cordgrass (Spartina alterniflora) and threesquare (Scirpus americanus), behind which the salt hays (Spartina patens and Distichlis spicata)

Note: Anthony L. Pacheco, Fishery Biologist (Research), Bureau of Commercial Fisheries Biological Laboratory, Beaufort, N.C., and George C. Grant, Department of Oceanography, University of Rhode Island, Kingston, R.I., formerly Fishery Biologist (Research), Bureau of Commerical Fisheries Field Station, Millville, Del.

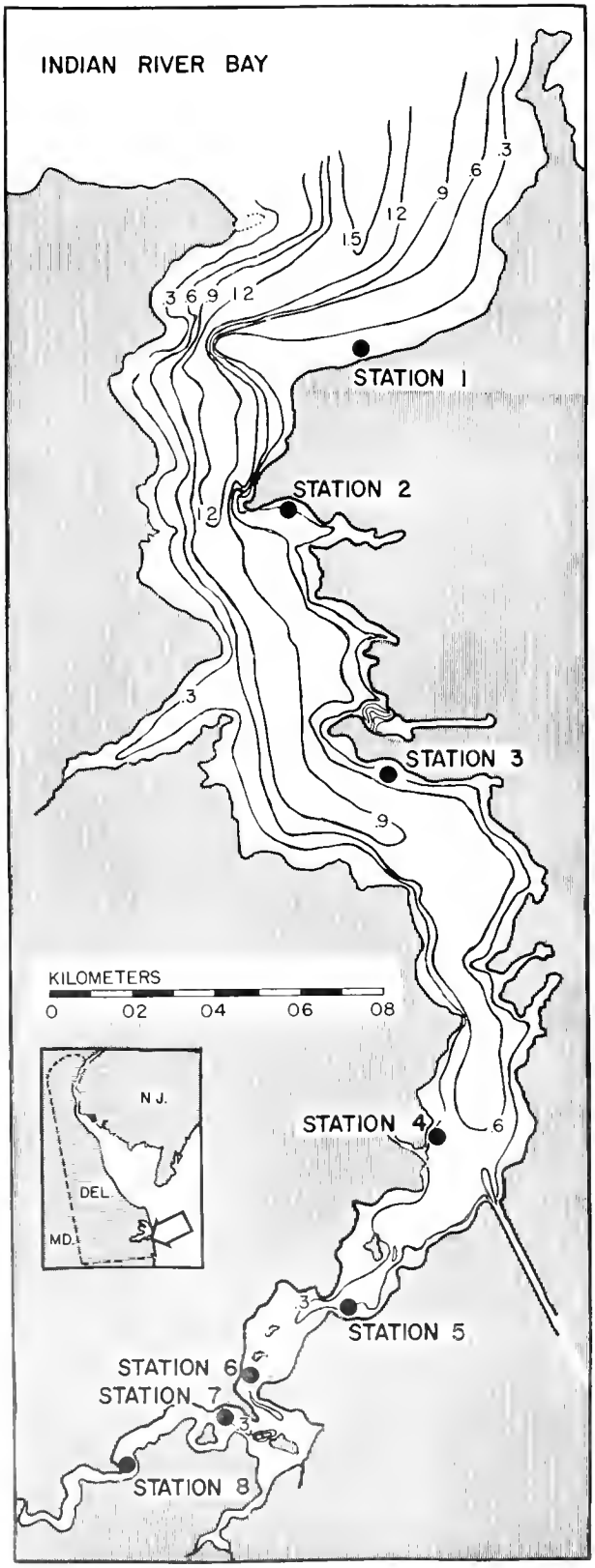

Figure 1.--White Creek, Del., with sampling locations, and water depth at mean low water in meters.

predominate. On higher ground, pines are abundant, primarily loblolly (Pinus taeda).

We analyzed appropriate aerial maps and used a depth profile survey by field station personnel to determine physiographic features. The creek is 4.7 km. long and drains a watershed of about 15 km.^{2}. The mean low-water surface area is 1.3 km.^{2}, with 80 percent less than 1 m. in depth (figure 2a). Volume at mean low water amounts to about 1,280 m.^{3}, with a mean tidal range of 0.5 m. The mean high-water volume is calculated to be about 1,940 m.^{3}. Intertidal volume amounts to about 34 percent of the mean high-water volume.

We established eight sampling locations, or stations, along the length of the creek. Station 1 was located seaward of a broad, gradually sloping, sandy beach, exposed to wave action from the bay. Station 2, located in a cove extending eastward from inside the creek mouth, was characterized by a narrow, sandy bottom inshore, grading to mud offshore. Stations 3 and 4 were located along narrow sand beaches, sloping gradually to a muddy sand bottom. Stations 5 and 6 were near narrow beaches which sloped to a sandy mud bottom. The upper creek stations, 7 and 8, were located adjacent to extensive intertidal flats, and had sticky mud bottoms.

Benthic vegetation was abundant seasonally, primarily between stations 2 and 4. The green algae (Ulva lactuca and Enteromorpha linza) and the red alga (Aghardiella tenera) were the principal forms.

Since detailed description of hydrographic observations will be the subject of another report in this series, we summarized only the general features in this report. Seasonal changes of surface water temperature were similar throughout the creek; monthly means and ranges are shown in figure 2b for each of four zones, formed by grouping two adjacent stations. Salinity varied continuously with changes in tide and season, resulting in a wide range of values. The overall mean and range of salinity at each station are shown in figure 2c.

MATERIALS AND METHODS

Generally, we collected fish every other day at each station during a 5-day workweek. We used beach seines of different lengths and mesh sizes during the survey. Spring and summer collections were made with a 7.5-m., 6-mm. stretched mesh seine, 1 m. deep; fall and winter collections were made with a 30-m., 12-mm. stretched mesh seine, 1.3 m. deep. A 15-m., 12-mm. stretched mesh seine, 1.3 m. deep, was used during the first three sampling days of August on an experimental basis. Because of ice cover during winter and early spring, collections were lacking for periods of up to 2 weeks.

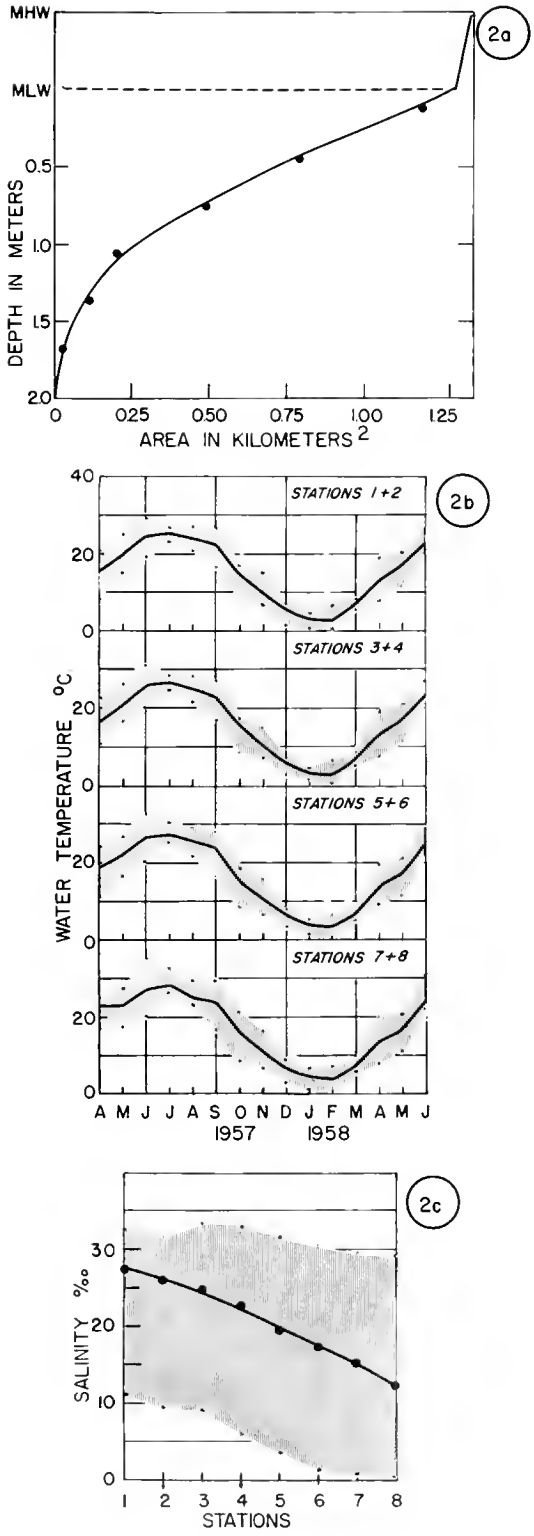

Figure 2.--a. Hypsograph (area and depth) of White Creek, Del. b. Monthly average and range of surface water temperature. c. Overall average and range of salinity at survey locations. MHW is mean high water; MLW is mean low water.

Individual collections were sorted, species identified and counted, and fork lengths recorded. Common and scientific names followed American Fisheries Society (1960). At times, many of the smaller anchovies, killifishes, and silversides (up to about 10 mm.) passed through the meshes of both nets, and, therefore, their numbers were not recorded in summary tables; however, notes on their occurrences were included.

We tabulated the collections by date, time, gear, surface water temperature, salinity, number of Atlantic menhaden, and combined numbers of all other species (append. table 1). Frequency of sampling varied; hence, availability is expressed in units of catch per seine haul. We made some comparisons between the catches of the different nets, but made no adjustment for variation in net efficiency.

SPECIES COMPOSITION AND SEASONAL OCCURRENCE

Fifty-eight species, representing 48 genera of 32 families, were collected (table 1). The catch, by species and size ranges, is summarized for each station, by month, in appendix table 2. A summary of the total monthly catch by species is included as table 2.

Various authors (Greeley, 1939; Warfel and Merriman, 1944; Pearcy and Richards, 1962) have classified fishes in seine collections according to the particular biotope considered. Any system of classification is arbitrary, because detailed information on reproduction and subsequent movements of young is limited or absent for many species. Our classification is similar to that of Pearcy and Richards (1962) and based generally on the seasonal relative abundance of larvae and juveniles. Some differences of details of their system and ours inevitably occur because of differences in fish fauna, physiography, and hydrography of the streams considered.

The following groupings are useful in describing the variation both in number and availability of species in White Creek:

I. Nonmigratory

1. Brackish water resident species.--Those which are hatched in the creek and may reside there throughout life: sheepshead minnow (Cyprinodon variegatus), mummichog (Fundulus heteroclitus), striped killifish (F. majalis), rainwater killifish (Lucania parva), fourspine stickleback (Apeltes quadracus), tidewater silverside (Menidia beryllina), and Atlantic silverside (M. menidia).

2. Fresh-water species.--These were infrequently collected and derived from

Table 1.--Checklist of species collected from White Creek, Del., during survey

Dasyatidae - stingrays

Bluntnose stingray (Dasyatis sayi)

Elopidae - tarpons

Ladyfish (Elops saurus)

Clupeidae - herrings

Blueback herring (Alosa aestivalis)

Alewife (A. pseudoharengus)

Atlantic menhaden (Brevoortia tyrannus)

Engraulidae - anchovies

Striped anchovy (Anchoa hepsetus)

Bay anchovy (A. mitchilli)

Silver anchovy (Anchoviella eurystole)

Umbridae - mudminnows

Eastern mudminnow (Umbra pygmaea)

Cyprinidae - minnows and carps

Golden shiner (Notemigonus crysoleucas)

Bridle shiner (Notropis bifrenatus)

Spottail shiner (Notropis hudsonius)

Anguillidae - fresh-water eels

American eel (Anguilla rostrata)

Belonidae - needlefishes

Atlantic needlefish (Strongylura marina)

Hemiramphidae - halfbeaks

Halfbeak (Hyporhamphus unifasciatus)

Cyprinodontidae - killifishes

Sheepshead minnow (Cyprinodon variegatus)

Banded killifish (Fundulus diaphanus)

Mummichog (F. heteroclitus)

Striped killifish (F. majalis)

Rainwater killifish (Lucania parva)

Poeciliidae - livebearers

Mosquitofish (Gambusia affinis)

Gadidae - codfishes and hakes

Pollock (Pollachius virens)

Gasterosteidae - sticklebacks

Fourspine stickleback (Apeltes quadracus)

Threespine stickleback (Gasterosteus aculeatus)

Syngnathidae - pipefishes and seahorses

Spotted seahorse (Hippocampus erectus)

Northern pipefish (Syngnathus fuscus)

Serranidae - sea basses

White perch (Roccus americanus)

Pomatomidae - bluefishes

Bluefish (Pomatomus saltatrix)

Carangidae - jacks, scads, and pompanos

Blue runner (Caranx crysos)

Crevalle jack (C. hippos)

Round scad (Decapterus punctatus)

Permit (Trachinotus falcatus)

Gerridae - mojarras

Spotfin mojarra (Eucinostomus argenteus)

Pomadasyidae - grunts

Pigfish (Orthopristis chrysopterus)

Sciaenidae - drums

Silver perch (Bairdiella chrysura)

Spotted seatrout (Cynoscion nebulosus)

Spot (Leiostomus xanthurus)

Northern kingfish (Menticirrhus saxatilis)

Atlantic croaker (Micropogon undulatus)

Black drum (Pogonias cromis)

Gobiidae - gobies

Naked goby (Gobiosoma bosci)

Seaboard goby (G. ginsburgi)

Green goby (Microgobius thalassinus)

Table 1.--Checklist of species collected from White Creek, Del., during survey--Continued

Triglidae - searobins	Bothidae - lefteye flounders
Northern searobin (Prionotus carolinus)	Summer flounder (Paralichthys dentatus)
Striped searobin (P. evolans)	Pleuronectidae - righteye flounders
Uranoscopidae - stargazers	Winter flounder (Pseudopleuronectes americanus)
Northern stargazer (Astroscopus guttatus)	Soleidae - soles
Blenniidae - combtooth blennies	Hogchoker (Trinectes maculatus)
Striped blenny (Chasmodes bosquianus)	Cynoglossidae - tonguefishes
Mugilidae - mullets	Blackcheek tonguefish (Symphurus plagiusa)
Striped mullet (Mugil cephalus)	Tetraodontidae - puffers
White mullet (M. curema)	Northern puffer (Sphaeroides maculatus)
Atherinidae - silversides	Batrachoididae - toadfishes
Rough silverside (Membras martinica)	Oyster toadfish (Opsanus tau)
Tidewater silverside (Menidia beryllina)	
Atlantic silverside (M. menidia)	

small, upstream populations: eastern mudminnow (Umbra pygmaea), golden shiner (Notemigonus crysoleucas), bridle shiner (Notropis bifrenatus), spottail shiner (N. hudsonius), banded killifish (Fundulus diaphanus), and mosquitofish (Gambusia affinis).

II. Migratory

3. Spring-fall species.--Migrants which generally enter the creek only during the warm season (most of these use the habitat as a nursery): Atlantic menhaden (Brevoortia tyrannus), striped anchovy (Anchoa hepsetus), bay anchovy (A. mitchilli), naked goby (Gobiosoma bosci), green goby (Microgobius thalassinus), striped mullet (Mugil cephalus), summer flounder (Paralichthys dentatus), winter flounder (Pseudopleuronectes americanus), and oyster toadfish (Opsanus tau).

4. Incidental species.--These occurred erratically in collections. Many undoubtedly are members of summer populations occurring in other locations within Indian River: silver anchovy (Anchoviella eurystole), halfbeak (Hyporhamphus unifasciatus), pollock (Pollachius virens), threespine stickleback (Gasterosteus aculeatus), spotted seahorse (Hippocampus erectus), northern pipefish (Syngnathus fuscus), white perch (Roccus americanus), bluefish (Pomatomus saltatrix), blue runner (Caranx crysos), crevalle jack (C. hippos), round scad (Decapterus punctatus), permit (Trachinotus falcatus), spotfin mojarra (Eucinostomus argenteus), pigfish (Orthopristis chrysopterus), silver perch (Bairdiella chrysura), spotted seatrout (Cynoscion nebulosus), spot (Leiostomus xanthurus), northern kingfish (Menticirrhus saxatilis), Atlantic croaker (Micropogon undulatus), black drum (Pogonias cromis), seaboard goby (Gobiosoma ginsburgi), northern stargazer (Astroscopus guttatus), striped blenny (Chasmodes bosquianus), white mullet (Mugil curema), rough silverside (Membras martinica), hogchoker (Trinectes maculatus), and blackcheek tonguefish (Symphurus plagiusa), and northern puffer (Sphaeroides maculatus).

5. Marine species.--Forms which are known to occur principally in the ocean but occasionally wander into the creek: bluntnose stingray (Dasyatis sayi), ladyfish (Elops saurus), northern searobin (Prionotus carolinus), and striped searobin (P. evolans).

6. Diadromous species.--Forms which are migratory between salt and fresh water. No sustaining populations of the river herrings occurred in the creek, but young of two species were seasonally available: blueback herring (Alosa

Table 2.--Number of fish collected each month in White Creek, Del., listed by species

Species	1957									1958					
	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
Dasyatis sayi	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Elops saurus	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Alosa aestivalis	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. pseudoharengus	-	-	-	-	-	-	-	1	-	-	-	-	3	-	1
Brevoortia tyrannus	329	13,697	1,637	3,241	2,599	9,480	3,996	4	41	26	-	-	509	2,605	3,085
Anchoa hepsetus	-	-	-	1	12	12	1	-	-	-	-	-	-	-	-
A. mitchilli	765	1,186	203	81	234	2,885	963	573	3	-	-	-	145	192	1,173
Anchoviella eurystole	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Umbra pygmaea	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Cyprinids	1	1	-	-	1	-	-	-	1	-	-	-	-	-	-
Anguilla rostrata	10	40	60	8	8	4	2	-	1	-	-	1	18	61	130
Strongylura marina	-	-	2	4	10	2	1	-	-	-	-	-	-	-	-
Hyporhamphus unifasciatus	-	-	-	-	5	-	-	-	-	-	-	-	-	-	1
Cyprinodon variegatus	47	384	374	259	51	81	986	3,438	890	595	68	266	485	234	504
Fundulus diaphanus	-	1	3	1	1	-	2	-	-	1	-	-	2	-	-
F. heteroclitus	1,257	2,918	2,964	1,750	2,156	2,445	2,804	1,921	91	7	-	97	7,177	4,095	7,270
F. majalis	57	267	190	245	230	553	312	533	41	43	-	21	338	216	483
Lucania parva	22	50	138	403	1,245	120	174	124	202	108	18	32	144	179	428
Gambusia affinis	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Pollachius virens	-	-	-	-	-	-	-	-	-	-	-	1	4	-	-
Apeltes quadracus	-	-	15	16	25	1	10	7	14	7	2	8	17	13	90
Gasterosteus aculeatus	-	6	-	-	-	-	-	-	-	-	-	-	-	1	-
Hippocampus erectus	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Syngnathus fuscus	-	-	2	10	12	3	6	-	-	-	-	-	-	-	6
Roccus americanus	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-
Pomatomus saltatrix	-	3	2	-	-	11	-	-	-	-	-	-	-	-	23
Caranx crysos	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
C. hippos	-	-	-	20	-	1	1	-	-	-	-	-	-	-	-
Decapterus punctatus	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Trachinotus falcatus	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Eucinostomus argenteus	-	-	-	-	1	4	14	-	-	-	-	-	-	-	-
Orthopristis chrysopterus	-	-	-	-	2	16	2	-	-	-	-	-	-	-	-
Bairdiella chrysura	-	-	-	148	674	507	98	-	-	-	-	-	-	-	1
Cynoscion nebulosus	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Leiostomus xanthurus	-	2	-	8	13	23	-	-	-	-	-	-	-	-	-
Menticirrhus saxatilis	-	-	-	1	-	2	-	-	-	-	-	-	-	-	-
Micropogon undulatus	-	-	-	-	-	-	2	3	2	1	-	-	-	-	-
Pogonias cromis	-	-	-	1	2	12	14	-	-	-	-	-	-	-	-
Gobiosoma bosci	2	21	9	77	128	151	109	22	18	-	-	1	39	26	134
G. ginsburgi	-	-	-	1	-	1	-	-	1	-	-	-	-	-	-
Microgobius thalassinus	-	3	4	79	369	392	37	7	-	-	-	-	23	11	77
Prionotus carolinus	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
P. evolans	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Astroscopus guttatus	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Chasmodes bosquianus	-	-	-	-	-	2	1	-	3	-	-	1	-	-	-
Mugil cephalus	128	41	8	13	16	22	48	5	13	24	-	-	826	732	1,177
M. curema	-	-	125	191	180	187	95	-	-	-	-	-	-	-	460
Membras martinica	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-
Menidia beryllina	1,878	3,820	3,948	1,085	550	2,276	2,319	1,076	80	642	85	957	1,884	1,550	1,860
M. menidia	130	170	683	884	2,065	6,855	5,301	5,475	3,269	5,233	19	938	2,791	32	96
Paralichthys dentatus	-	5	1	1	17	20	13	1	-	-	-	-	9	5	12
Pseudopleuronectes americanus	-	-	-	4	36	39	32	6	3	2	-	1	6	9	57
Trinectes maculatus	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-
Symphurus plagiusa	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Sphaeroides maculatus	-	-	-	1	1	-	-	-	-	-	-	-	-	-	3
Opsanus tau	-	2	1	27	93	71	13	-	-	-	-	-	1	-	4

aestivalis), alewife (A. pseudoharengus), and American eel (Anguilla rostrata).

Seasonal fluctuations in the number of species in the foregoing groups are shown in figure 3. The sharp decrease in number of species from October to February corresponds to a period of rapid cooling. In February, when coldest water temperatures occurred, only resident species were taken in samples. Warfel and Merriman (1944) described a similar relation between temperature and numbers of species from Morris Cove, Conn.; however, they caught no fish in winter in waters below 4° C.

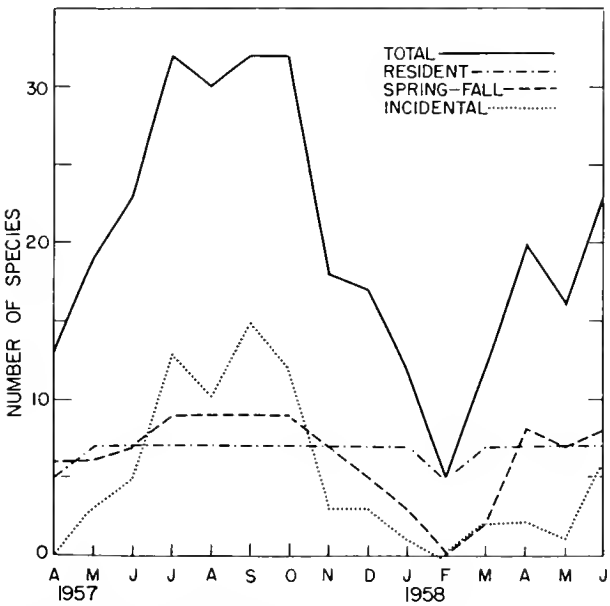

Figure 3.--Seasonal distribution in numbers of fish species in White Creek, Del.

Two peaks in availability of fish in White Creek were indicated from the seasonal distribution of catches per unit haul (figure 4). An early peak in May consisted principally of Atlantic menhaden. The second peak, in November, was composed almost completely of four resident species (Atlantic and tidewater silversides, mummichog, and sheepshead minnow). Lowest level of availability occurred in February, coincident with minimum water temperatures. The dominance of Atlantic menhaden among spring-fall migrants is obvious when the abundance of Atlantic menhaden shown in the upper part of figure 4 is compared with abundance of all spring-fall migrants shown in the lower portion.

The change in length of seines employed should be considered in interpreting figure 4. The 7.5-m. seine was used from April to September, and the 30-m. seine from late fall to early spring. Thus, the September peak of Atlantic menhaden probably results from improved net efficiency rather than from increased abundance. Also, some increase in availability may have occurred as the fish grouped into larger schools prior to emigration.

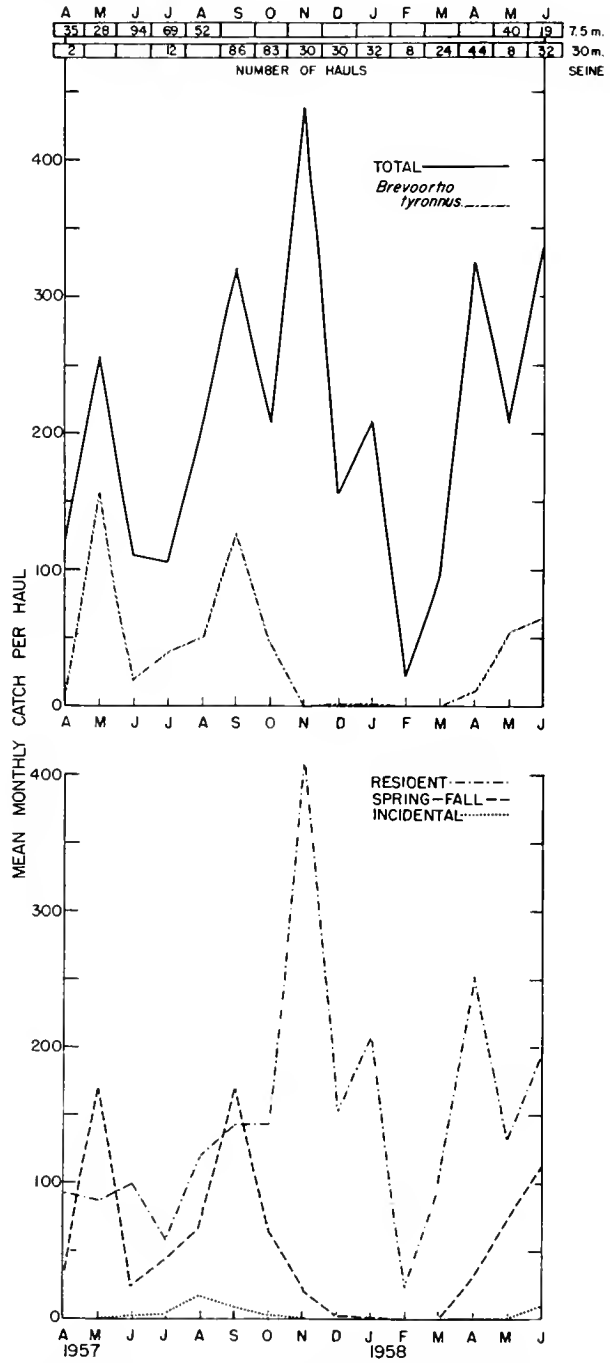

Figure 4.--Seasonal abundance of fishes in White Creek, Del., indicated from the average monthly seine catches.

DISTRIBUTION OF PRINCIPAL SPECIES

Seasonal variation in the relative abundance of the principal species occurring in the foregoing arbitrary groups is shown in figure 5

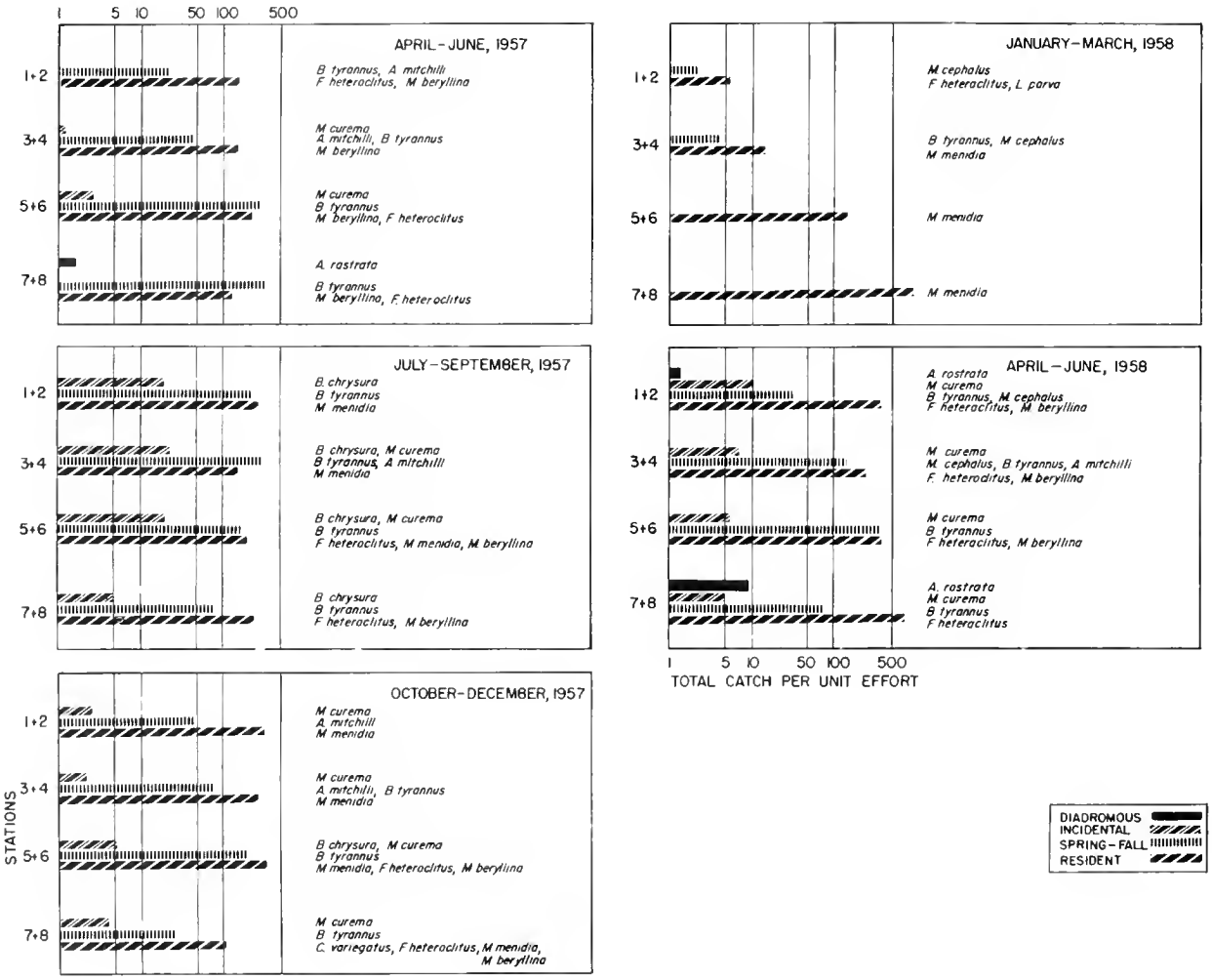

Figure 5.--Total catch per seine haul, by 3-month intervals, of principal species groups occurring in White Creek, Del., plotted on a logarithmic scale. Listed species made up about two-thirds of each group catch. Where two or more species are included, listing is in the order of decreased availability.

(catches of each two adjacent stations were combined). A small number of species constituted at least two-thirds of each group total and varied between seasons and stations. Several species, including the Atlantic menhaden, sheepshead minnow, mummichog, and tidewater silverside, demonstrated a seasonal upstream preference. These contrasted with a fairly uniform distribution of most other species. Incidental species were regarded as strays from outside the creek. Although at times they occurred throughout the creek, incidental species appeared mostly at downstream stations.

Change of species composition within groups generally was graded smoothly over the length of the creek; however, the lumping of species by station groups in figure 5 suggests some discontinuity. For example, the principal resident species shifted from silversides to killifishes upstream during summer and fall. On the other hand, there was an apparent irregularity in the distribution of the mummichog, rainwater killifish, and fourspine and threespine sticklebacks (append. table 2). This irregularity occurred at station 2 where, although salinities corresponded to those of lower White Creek, a small tributary entered the cove and habitat characteristics were similar to those in upper White Creek.

Species predominating within certain groups changed seasonally. The Atlantic silverside

Table 3.--Coefficients of association between the six most abundant species, by Cole's Index. Value scale extends from +1 (perfect association) to -1 (perfect disassociation)

	Cyprinodon variegatus	Brevoortia tyrannus	Fundulus heteroclitus	Menidia beryllina	Anchoa mitchilli	Menidia menidia
C. variegatus	---	0.209	0.075	0.063	-0.105	-0.155
B. tyrannus	0.209	---	.531	.592	.298	.127
F. heteroclitus	.075	.531	---	.394	.318	-.104
M. beryllina	.063	.592	.394	---	.370	.026
A. mitchilli	-.105	.298	.318	.370	---	.122
M. menidia	-.155	-.127	-.104	.026	.122	---

from late spring until the following early spring gradually displaced the tidewater silverside (figure 5). Atlantic menhaden generally remained the principal spring-fall migrant, but downstream was replaced by the bay anchovy during late fall and early spring.

The catch-per-unit-effort, by species, during 3-month intervals, is summarized in appendix table 2. In addition, the monthly catch of all species, with corresponding range in fork lengths, is listed by station in appendix table 3.

The occurrences of the principal species appear to be related. Interspecific association of the six most abundant species was determined from 820 samples in 2 x 2 contingency tables and Cole's Index (Cole, 1949, 1957). This coefficient indicates what proportion of the association possible was actually found within the series of collections. Range of coefficients may vary from +1 when species occur together as many times as possible, to -1 when species occur together the minimum number of times. Coefficients (table 3) ranged from 0.592 to -0.127. The relative occurrence is diagrammed in figure 6. Chi-square values resulted in probabilities $\cong 0.15$ for M. menidia paired with M. beryllina and F. heteroclitus. All other P values were less than 0.5, indicating association coefficients were statistically significant.

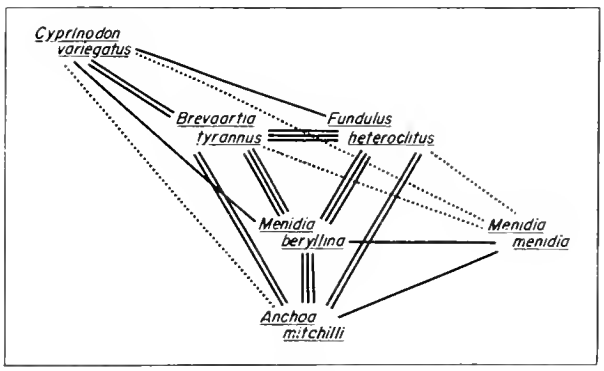

Figure 6.--Interspecific association between the six most abundant species occurring in White Creek, Del. Solid lines indicate positive association; broken lines, negative association.

SEASONAL OCCURRENCES OF SMALLEST SPECIMENS

The sequence in availability of the smallest specimens taken (table 4) provides a clue to spawning time of the various species in local waters. Of the clupeid fishes collected, only the Atlantic menhaden occurred in larval stages. Although the smallest Atlantic menhaden (22 mm.) occurred in May, their first appearance was made in collections during November. The greatest number of species in the list of small specimens were available in late spring; however, the smallest cyprinodont larvae (10 mm.) were collected from June to August. This group included important residents: the mummichog, striped killifish, sheepshead minnow, and rainwater killifish.

Table 4.--Size and month of collection of smallest specimens for the most abundant species

Common name	Fork length	Month
	mm.	
Pollock	39	March
American eel	50	April
Summer flounder	23	April
Atlantic menhaden	22	May
Fourspine stickleback	19	May
Bluefish	39	May
Spot	48	May
Atlantic silverside	8	May
Winter flounder	42	May
Bay anchovy	12	June
Sheepshead minnow	10	June
Mummichog	10	June
Striped killifish	15	June
Rainwater killifish	13	June
Northern pipefish	41	June
Tidewater silverside	10	June
Naked goby	11	July
Green goby	8	July
White mullet	20	July
Silver perch	7	August
Striped mullet	22	November
Atlantic croaker	16	December

DISCUSSION

Seasonal and spatial trends in the distribution of fishes are evident; however, synoptic differences in availability are difficult to evaluate because of variations in sampling gear. Change in length of net from 7.5 m. to 30 m. in September did not increase the number of species sampled (figure 3), but the possible increased efficiency, reflected by higher catches, probably accounted for the September peak in catch-per-unit-effort (figure 4). DeLacy and English (1954), sampling along an exposed shore, experienced a consistent and impressive increase in diversity of species and in numbers caught, with a 120-ft. seine as compared with replicate hauls of a 60-ft. seine.

In a small tributary, with shores converging upstream, a valid coefficient of relative seine efficiency, applicable to all species involved, is difficult to obtain. For example, from seine collections made on 13 sampling dates from July 12 to August 26, the following sequence of catch per haul of Atlantic silversides and menhaden was made in lower (station 1-3) and upper (station 4-6) creek areas (table 5). Unfortunately, we did not attempt a concentrated effort to compare efficiencies of the different gear in the same day and in the same area.

Table 5.--Comparative catch per seine haul of Atlantic silversides and Atlantic menhaden by different nets

Seine length	Atlantic silverside		Atlantic menhaden		Sampling period	Hauls
	Sta. 1-3	Sta. 4-6	Sta. 1-3	Sta. 4-6		
M.						No.
7.5	13.0	2.0	0.0	2.1	7/12-22	12
30.0	59.7	23.3	201.3	393.7	7/26-29	6
15.0	20.3	13.1	2.4	6.2	8/2-9	9
30.0	66.8	37.3	101.1	85.3	8/12-26	12

The Atlantic silverside catch appeared to be related fairly closely to the length of net used. For Atlantic menhaden, the 30-m. net was considerably more effective than either the 7.5-m. or 15-m. length. In lower creek stations the 7.5-m. net appeared to be completely inefficient for menhaden. Aside from sweep area of a seine, variable factors, such as schooling behavior, distribution, and size of fish, obviously must be considered in making seining efforts productive. We made the changeover to a 30-m. seine on this basis, returning to the 7.5-m. net the following spring to prevent the decimation of larvae through excessive catches.

These data tend to corroborate the conclusion of Allen, DeLacy, and Gotshall (1960) that efficiency of gear for one species in one area does not imply equal efficiency for the same species in another area.

Despite the limitations of sampling, it is evident that White Creek is an important nursery, both for summer migrants and resident species. In this respect it is similar to larger tributaries. Comparison of species checklists of DeSylva, Kalber, and Schuster (1962) and Schwartz (1961) with that of the present study indicated 40 species in common with Delaware Bay, and 29 with Chincoteague and Sinepuxent Bays, Md., and 21 species common to all three locations. Differences in the fish fauna of White Creek and Delaware Bay resulted mainly from the variety of fresh-water species in Delaware Bay and the occurrences of incidental species in White Creek. Chincoteague and Sinepuxent Bays are essentially tidal

lagoons and, consequently, have proportionately more marine forms. Except for regional differences which influence the occurrence of incidental forms, fish species in White Creek were remarkably similar to those found in Mystic River, Conn., by Pearcy and Richards (1962). The conspicuous absence of Atlantic menhaden in Mystic River summer migrant population, however, may be related to the types of sampling gears employed. Short seines, beam and otter trawls, and hooks do not effectively catch menhaden.

At present, there appears to be active interest in utilizing much more of the White Creek shoreline for residential development. This will involve creek bottom dredging, marsh filling, and shore bulkheading. The present study may prove useful in evaluating ecological effects of such actions upon the future fish populations of this nursery area.

LITERATURE CITED

ALLEN, GEORGE H., ALLAN C. DELACY, and DANIEL W. GOTSHALL.
1960. Quantitative sampling of marine fishes--a problem in fish behavior and fishing gear. In E. A. Pearson (editor), Proceedings of the first international conference on waste disposal in the marine environment, p. 448-511. Pergamon Press, New York.

AMERICAN FISHERIES SOCIETY.
1960. A list of common and scientific names of fishes from the United States and Canada. 2d ed. Spec. Publ. 2, 102 p.

COLE, LAMONT C.
1949. The measurement of interspecific association. Ecology 30:411-424.
1957. The measurement of partial interspecific association. Ecology 38: 226-233.

DELACY, ALLAN C., and THOMAS S. ENGLISH.
1954. Variations in beach seine samples caused by net length and repeated hauls. Ecology 34:18-20.

DESYLVA, DONALD P., FREDERICK A. KALBER, JR., and CARL N. SHUSTER, JR.
1962. Fishes and ecological conditions in the shore zone of the Delaware River estuary, with notes on other species collected in deeper water. Univ. Del., Mar. Lab. Inform. Ser. Publ. 5, 164 p.

GREELEY, J. R.
1939. Fishes and habitat conditions of the shore zone based upon July and August seining investigations. In A biological survey of the salt waters of Long Island, 1938, p. 72-91. No. 15. Pt. 2. Suppl. 28th Annu. (1938). N. Y. Conserv. Dep.

JUNE, FRED C., and J. LOCKWOOD CHAMBERLIN.
1959. The role of the estuary in the life history and biology of Atlantic menhaden. Proc. Gulf Caribbean Fish. Inst. 11th Annu. Sess. (1958), p. 41-45.

MASSMANN, W. H., E. C. LADD, and H. N. McCUTCHEON.
1952. A biological survey of the Rappahannock River, Virginia. Va. Fish. Lab. Spec. Sci. Rep. 6, 221 p.

PEARCY, WILLIAM G., and SARAH W. RICHARDS
1962. Distribution and ecology of fishes of the Mystic River estuary, Connecticut. Ecology 43:248-259.

RANEY, EDWARD C., and WILLIAM H. MASSMANN.
1953. The fishes of the tidewater section of the Pamunkey River, Virginia. J. Wash. Acad. Sci. 43:424-432.

SCATTERGOOD, LESLIE W., PARKER S. TREFETHEN, and GARETH W. COFFIN.
1951. Notes on the size of menhaden taken in Maine during 1949. Copeia 1951 (1):93-94.

SCHWARTZ, FRANK J.
1961. Fishes of Chincoteague and Sinepuxent Bays. Amer. Midland Natur. 65:384-408.

SUTHERLAND, DOYLE F.
1963. Variation in vertebral numbers of juvenile Atlantic menhaden. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 435, 21 p.

WARFEL, HERBERT E., and DANIEL MERRIMAN.
1944. Studies on the marine resources of southern New England. I. An analysis of the fish population of the shore zone. Bull. Bingham Oceanogr. Collect. 9 (Art. 2), 91 p.

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Appendix table 1.--Stations occupied, with salinity and temperature data, numbers of Atlantic menhaden and of all other fishes collected; White Creek, Del., 1957-58

Date	Station	Time	Seine length	Salinity	Temperature	Menhaden	Other fishes
		E.s.t.	M.	P.p.t.	°C.	Number	Number
4/15/57	1	1010	7.5	29.1	8.2	0	3
	2	1030	7.5	26.2	9.4	0	3
	3	1040	7.5	25.6	10.6	--	--
	4	1050	7.5	19.3	10.8	--	--
	5	1100	7.5	13.9	11.2	0	33
	6	1115	7.5	14.2	11.9	0	74
4/17/57	1	0950	7.5	26.6	11.0	0	0
	2	1000	7.5	23.0	11.4	0	0
	3	1010	7.5	21.9	12.4	0	29
	4	1025	7.5	19.7	12.7	0	12
	5	1035	7.5	19.0	13.2	4	167
	6	1110	7.5	20.6	14.0	30	447
4/19/57	1	1015	7.5	26.5	15.4	0	30
	2	1030	7.5	27.3	15.4	0	124
	3	1050	7.5	25.8	16.4	0	17
	4	1100	7.5	23.4	16.3	0	8
	5	1115	7.5	21.8	16.3	1	22
	6	1130	30.0	19.6	16.7	171	138
	7	1150	30.0	16.5	17.0	2	284
4/22/57	1	1000	7.5	27.3	18.8	0	14
	2	1015	7.5	26.5	19.0	0	317
	3	1035	7.5	24.7	20.7	0	124
	4	1055	7.5	21.3	20.2	0	22
	5	1110	7.5	16.8	19.9	3	129
	6	1130	7.5	15.4	20.5	14	109
4/24/57	1	1010	7.5	26.1	20.7	0	2
	2	1030	7.5	25.1	19.4	0	16
	3	1040	7.5	23.7	21.7	0	143
	4	1100	7.5	20.0	23.1	0	60
	5	1120	7.5	11.1	23.6	0	337
	6	1130	7.5	5.5	24.0	0	254
	7	1150	7.5	5.2	25.7	3	55
4/26/57	1	1020	7.5	27.1	19.1	0	8
	2	1050	7.5	26.6	20.7	0	173
	3	1115	7.5	25.6	21.0	0	40
	4	1135	7.5	22.0	22.2	0	602
	5	1155	7.5	15.4	23.0	170	314
	6	1225	7.5	10.2	24.2	97	169
	7	1305	7.5	4.9	25.5	2	57
5/1/57	1	0950	7.5	27.0	20.6	0	25
	2	1013	7.5	26.1	19.6	0	28
	3	1030	7.5	26.1	20.7	0	50
	4	1050	7.5	24.6	21.3	0	47
	5	1120	7.5	20.9	22.7	20	182
	6	1133	7.5	21.8	22.7	0	95
	7	1145	7.5	19.7	23.9	44	263
5/3/57	1	0910	7.5	27.8	14.9	0	1
	2	0930	7.5	27.1	14.5	0	24
	3	0950	7.5	26.7	16.5	0	102
	4	1010	7.5	24.9	16.7	0	7
	5	1025	7.5	24.2	16.6	0	53
	6	1040	7.5	22.9	16.5	1	2
	7	1100	7.5	22.6	16.7	0	10
	8	1215	7.5	21.0	17.6	4	62
5/6/57	1	0930	7.5	27.6	16.3	0	1
	2	0945	7.5	27.0	15.2	0	90
	3	1010	7.5	26.9	16.5	0	44
	4	1025	7.5	23.5	17.8	0	134
	5	1045	7.5	17.1	17.9	82	217
	6	1115	7.5	16.3	18.1	20	103
	7	1130	7.5	11.4	18.2	1	78
5/8/57	1	0910	7.5	26.5	17.9	0	56
	2	0940	7.5	24.9	17.6	0	276
	3	1010	7.5	22.6	18.7	0	44
	4	1020	7.5	23.8	21.4	0	73
	5	1045	7.5	17.2	21.8	106	87
	6	1255	7.5	14.2	27.9	206	120
	7	1330	7.5	15.6	27.3	117	49
5/10/57	1	0825	7.5	26.6	19.9	0	68
	2	0850	7.5	25.0	20.3	0	151
	3	0915	7.5	24.1	20.8	55	49
	4	0935	7.5	24.3	21.6	0	173
	5	0950	7.5	20.4	22.2	245	194
	6	1025	7.5	15.4	23.5	5	157
	7	1045	7.5	9.8	24.5	0	126
5/13/57	1	0915	7.5	28.9	20.5	0	25
	2	0935	7.5	27.1	21.3	1	188
	3	0955	7.5	26.4	21.8	0	325
	4	1020	7.5	26.0	22.7	0	59
	5	1040	7.5	23.9	23.7	1,146	46
	6	1105	7.5	20.1	24.5	570	112
	7	1145	7.5	18.8	26.1	20	172
5/15/57	1	0810	7.5	28.9	21.0	0	27
	2	0835	7.5	27.5	22.7	1	170
	3	0900	7.5	26.9	23.2	0	33
	4	0920	7.5	24.7	24.2	25	105
	5	0940	7.5	21.9	24.5	487	26
	6	1000	7.5	22.3	25.3	717	112
	7	1015	7.5	19.2	25.7	206	60
5/17/57	1	0835	7.5	28.8	19.8	0	41
	2	0900	7.5	27.9	19.9	0	147
	3	0925	7.5	27.6	20.7	0	63
	4	0945	7.5	25.5	20.7	0	102
	5	1000	7.5	24.0	20.8	200	87
	6	1015	7.5	21.7	21.0	220	294
	7	1035	7.5	19.2	21.6	800	40
5/20/57	1	0910	7.5	28.3	18.0	0	41
	2	0930	7.5	27.8	17.9	0	31
	3	0945	7.5	27.4	18.3	0	25
	4	1005	7.5	24.1	18.5	19	39
	5	1020	7.5	19.0	18.4	124	138
	6	1040	7.5	17.2	18.2	2,080	68
	7	1100	7.5	14.7	18.2	1,744	131
	8	1125	7.5	12.0	18.6	767	39
5/22/57	1	1010	7.5	29.1	16.0	0	18
	2	1035	7.5	28.0	15.7	0	71
	3	1100	7.5	26.5	16.4	0	37
	4	1125	7.5	24.0	17.4	2	187
	5	1145	7.5	18.6	17.8	42	71
	6	1210	7.5	17.4	18.2	98	171
	7	1230	7.5	16.9	19.3	2,157	122
5/24/57	1	0850	7.5	28.4	22.1	0	59
	2	0935	7.5	26.4	23.3	1	188
	3	0945	7.5	26.7	23.2	0	106
	4	1010	7.5	24.3	23.9	200	142
	5	1035	7.5	23.9	25.1	42	76
	6	1055	7.5	20.4	26.1	54	133
	7	1120	7.5	18.2	28.1	28	77
5/27/57	1	1045	7.5	28.6	24.6	0	49
	2	1100	7.5	27.3	24.9	0	52
	3	1115	7.5	27.1	25.5	0	136
	4	1140	7.5	25.5	26.1	0	92
	5	1155	7.5	21.7	26.6	8	125
	6	1210	7.5	20.5	27.0	92	107
	7	1225	7.5	15.8	27.7	21	57
5/29/57	1	0910	7.5	29.2	21.5	0	62
	2	0925	7.5	28.1	21.1	0	58
	3	0945	7.5	28.1	21.8	0	29
	4	1000	7.5	26.0	21.8	1	153
	5	1040	7.5	24.2	22.4	9	175
	6	1105	7.5	21.6	22.8	2	74
	7	1125	7.5	20.1	23.1	125	87
	8	1215	7.5	14.0	23.4	141	111
5/31/57	1	0915	7.5	29.6	20.7	0	14
	2	0950	7.5	28.9	21.9	0	69
	3	1015	7.5	28.6	22.2	0	25
	4	1035	7.5	27.0	22.9	0	16
	5	1100	7.5	25.6	23.6	2	91
	6	1120	7.5	22.6	24.4	5	85
	7	1140	7.5	20.5	25.5	16	45
	8	1200	7.5	17.7	25.9	9	31
6/3/57	1	0825	7.5	29.0	22.3	0	24
	2	0850	7.5	29.2	23.8	0	315
	3	0920	7.5	28.9	23.3	1	356
	4	0955	7.5	26.7	23.4	4	33
	5	1015	7.5	24.7	22.9	0	156
	6	1035	7.5	22.9	22.5	0	26
	7	1050	7.5	21.7	22.2	454	25
	8	1105	7.5	17.1	21.8	0	151

Appendix table 1.--Continued

Date	Station	Time	Seine length	Salinity	Temperature	Menhaden	Other fishes
		E.s.t.	M.	P.p.t.	°C.	Number	Number
6/5/57	1	0830	7.5	29.3	20.0	0	78
	2	0855	7.5	28.1	20.3	0	171
	3	0920	7.5	27.3	20.6	0	103
	4	0950	7.5	21.3	20.0	0	109
	5	1010	7.5	17.5	20.1	0	181
	6	1030	7.5	11.5	20.1	1	110
	7	1055	7.5	8.9	20.6	5	84
	8	1130	7.5	6.7	20.1	36	89
6/7/57	1	0855	7.5	26.5	20.7	0	80
	2	0935	7.5	21.2	21.4	1	13
	3	0950	7.5	21.3	21.9	11	105
	4	1030	7.5	24.3	22.5	0	77
	5	1055	7.5	13.3	23.3	5	132
	6	1120	7.5	6.1	24.3	0	163
	7	1210	7.5	4.5	26.3	1	39
	8	1300	7.5	2.3	27.4	75	208
6/10/57	1	0925	7.5	28.1	19.0	0	12
	2	0935	7.5	27.1	19.6	0	4
	3	1000	7.5	26.2	19.9	0	58
	4	1025	7.5	23.4	20.1	0	46
	5	1040	7.5	16.4	20.5	70	66
	6	1100	7.5	13.2	21.4	7	12
	7	1115	7.5	10.4	21.6	0	53
	8	1140	7.5	6.2	21.7	0	59
6/12/57	1	0800	7.5	28.0	21.7	0	45
	2	0825	7.5	26.4	22.2	10	37
	3	0845	7.5	24.8	22.9	1	62
	4	0920	7.5	22.2	23.8	8	139
	5	0945	7.5	20.4	24.3	3	47
	6	0955	7.5	19.1	24.5	0	7
	7	1010	7.5	16.7	25.2	0	12
	8	1020	7.5	12.1	25.6	31	65
6/14/57	1	0808	7.5	28.2	23.7	0	40
	2	0830	7.5	26.3	25.2	0	30
	3	0850	7.5	25.4	25.8	0	63
	4	0920	7.5	24.1	26.4	0	14
	5	0950	7.5	22.0	28.1	0	44
	6	1010	7.5	21.2	28.2	1	10
	7	1025	7.5	20.7	28.7	0	14
	8	1045	7.5	16.0	29.3	0	58
6/17/57	1	0905	7.5	28.4	28.1	2	44
	2	0930	7.5	27.9	28.8	0	135
	3	1015	7.5	27.4	30.4	3	174
	4	1100	7.5	24.7	31.6	0	71
	5	1120	7.5	23.7	32.2	0	316
	6	1145	7.5	20.9	33.3	0	172
	7	1215	7.5	19.5	35.5	1	45
	8	1235	7.5	16.8	35.8	0	95
6/19/57	1	0805	7.5	28.7	27.9	9	50
	2	0830	7.5	28.3	28.4	14	88
	3	0850	7.5	27.5	29.4	6	52
	4	0915	7.5	26.3	30.5	42	136
	5	0945	7.5	22.6	31.0	0	136
	6	1010	7.5	20.2	31.6	0	274
	7	1035	7.5	17.9	32.2	76	84
	8	1055	7.5	12.4	33.5	0	43
6/21/57	1	0810	7.5	29.4	26.4	0	63
	2	0835	7.5	28.3	26.3	0	145
	3	0900	7.5	28.2	27.3	0	44
	4	0920	7.5	26.7	27.6	0	62
	5	0935	7.5	23.1	28.3	0	466
	6	0955	7.5	18.1	28.8	124	64
	7	1015	7.5	14.9	29.6	64	54
6/24/57	1	0845	7.5	29.0	27.0	0	41
	2	0905	7.5	28.1	26.9	251	47
	3	0935	7.5	25.8	27.5	0	163
	4	1000	7.5	26.4	28.4	2	178
	5	1025	7.5	21.8	28.9	1	33
	6	1045	7.5	18.5	30.6	27	131
	7	1115	7.5	14.6	32.0	36	172
6/26/57	1	0805	7.5	29.6	24.8	0	101
	2	0830	7.5	28.4	26.1	0	50
	3	0900	7.5	27.2	26.2	0	51
	4	0910	7.5	26.3	27.2	0	46
	5	0930	7.5	24.6	27.1	0	84
	6	0955	7.5	23.2	26.9	7	49
	7	1015	7.5	22.2	27.0	25	41
	8	1030	7.5	17.9	26.6	128	80
6/28/57	1	0755	7.5	30.5	24.3	0	601
	2	0810	7.5	29.6	25.9	0	347
	3	0830	7.5	28.6	26.4	0	11
	4	0845	7.5	26.6	27.0	0	43
	5	0910	7.5	25.6	27.6	0	23
	6	0930	7.5	24.3	28.0	92	8
	7	0945	7.5	23.6	28.6	0	15
	8	1000	7.5	21.7	28.7	1	59
7/1/57	1	0830	7.5	30.6	--	0	3
	2	0950	7.5	30.2	--	0	10
	3	0925	7.5	29.7	--	143	17
	4	1010	7.5	26.8	25.2	0	22
	5	1020	7.5	25.9	25.7	0	12
	6	1035	7.5	25.5	26.0	0	75
	7	1100	7.5	23.3	26.2	2	30
	8	1125	7.5	24.1	26.5	9	28
7/3/57	1	0830	7.5	31.5	24.2	0	40
	2	0855	7.5	29.7	24.5	0	102
	3	0920	7.5	29.2	24.8	0	65
	4	0940	7.5	28.1	25.1	0	20
	5	1020	7.5	25.9	25.7	0	41
	6	1035	7.5	24.9	26.0	0	56
	7	1055	7.5	23.7	26.2	2	15
	8	1110	7.5	19.4	27.4	0	18
7/5/57	1	0820	7.5	30.7	25.5	0	74
	2	0960	7.5	30.1	25.5	0	49
	3	0935	7.5	28.9	26.0	0	65
	4	1005	7.5	27.7	26.3	106	31
	5	1040	7.5	25.0	27.5	12	44
	6	1120	7.5	20.0	28.7	8	54
	7	1150	7.5	16.3	29.5	0	99
	8	--	7.5	--	--	--	--
7/8/57	1	0830	7.5	30.3	25.1	0	42
	2	0850	7.5	29.7	26.2	0	113
	3	0920	7.5	28.9	26.6	0	42
	4	0950	7.5	28.6	28.0	0	59
	5	1015	7.5	25.4	28.6	1	76
	6	1035	7.5	24.2	28.1	0	70
	7	1055	7.5	21.3	29.6	0	72
	8	1115	7.5	13.8	29.9	0	184
7/10/57	1	0805	7.5	30.3	23.4	0	8
	2	0820	7.5	30.1	23.3	0	19
	3	0835	7.5	29.8	24.8	1	26
	4	0855	7.5	28.5	26.2	1	20
	5	0935	7.5	27.5	27.9	0	43
	6	0950	7.5	26.0	26.7	1	22
	7	1005	7.5	25.1	27.4	0	33
	8	1025	7.5	22.0	27.3	0	77
7/12/57	1	0810	7.5	31.0	24.0	0	46
	2	0830	7.5	30.7	23.8	0	40
	3	0855	7.5	29.8	24.6	0	119
	4	0920	7.5	29.1	25.3	0	12
	5	0950	7.5	27.7	25.6	0	39
	6	1010	7.5	26.0	26.7	1	39
	7	1025	7.5	25.1	27.5	0	42
	8	1050	7.5	18.7	26.8	0	40
7/15/57	1	0825	7.5	30.1	26.0	0	37
	2	0845	7.5	30.1	26.7	2	12
	3	0910	7.5	29.8	27.7	0	49
	4	0935	7.5	28.5	28.2	9	11
	5	0955	7.5	27.7	28.5	0	64
	6	1015	7.5	26.6	28.7	0	17
	7	1030	7.5	26.2	29.7	0	25
	8	1050	7.5	24.3	30.1	0	6
7/19/57	1	0825	7.5	30.9	25.5	0	65
	2	0850	7.5	30.5	25.3	0	84
	3	0915	7.5	30.2	26.3	0	32
	4	0935	7.5	29.5	26.3	0	109
	5	1005	7.5	27.2	26.7	0	23
	6	1030	7.5	26.6	27.2	6	14
	7	1055	7.5	25.1	27.6	5	44
7/22/57	1	0810	7.5	31.1	27.1	0	50
	2	0830	7.5	30.1	27.1	0	170
	3	0855	7.5	29.8	27.6	0	132
	4	0915	7.5	29.2	28.1	1	19
	5	0935	7.5	26.8	28.1	3	75
	6	0955	7.5	24.2	29.6	5	75
	7	1025	7.5	20.7	32.7	0	0

Appendix table 1.--Continued

Date	Station	Time	Seine length	Salinity	Temperature	Menhaden	Other fishes
		E.s.t.	M.	P.p.t.	°C.	Number	Number
7/26/57	1	0925	30.0	31.1	25.1	252	204
	2	0900	30.0	31.3	25.7	10	316
	3	0940	30.0	31.1	26.6	417	42
	4	1020	30.0	30.3	26.8	169	87
	5	1225	30.0	28.0	28.3	0	183
	6	1330	30.0	26.4	30.1	0	342
7/29/57	1	0820	30.0	31.3	24.2	75	215
	2	0850	30.0	31.0	24.9	328	175
	3	0935	30.0	30.7	25.9	631	78
	4	1110	30.0	30.5	26.9	1,038	144
	5	1150	30.0	30.5	27.4	1	82
	6	1230	30.0	29.7	27.6	0	48
8/2/57	1	0830	15.0	32.3	25.7	0	45
	2	0915	15.0	32.5	27.3	0	368
	3	0945	15.0	32.2	27.5	22	103
	4	1015	15.0	31.5	28.2	40	93
	5	1100	15.0	29.8	28.6	1	82
	6	1115	15.0	29.0	29.3	11	78
8/5/57	1	0810	15.0	32.5	25.5	0	33
	2	0830	15.0	32.6	25.8	0	319
	3	0915	15.0	32.2	26.6	0	90
	4	0940	15.0	30.5	26.6	0	69
	5	1005	15.0	29.3	27.0	0	58
	6	1025	15.0	28.4	27.4	4	92
	7	1045	15.0	27.3	29.7	4	123
8/9/57	1	0900	15.0	32.7	23.7	0	138
	2	0930	15.0	32.9	23.8	0	450
	3	1015	15.0	33.2	25.3	0	126
	4	1045	15.0	33.0	25.3	0	91
	5	1140	15.0	29.8	25.3	0	67
	6	1200	15.0	28.8	25.3	0	103
8/12/57	1	0925	30.0	32.5	24.8	1	150
	2	1005	30.0	33.0	25.4	1	267
	3	1050	30.0	32.7	26.2	247	188
	4	1135	30.0	32.7	26.9	153	103
	5	1245	30.0	31.7	27.3	97	108
	6	1330	30.0	30.4	27.3	0	67
8/16/57	1	0755	30.0	32.6	24.3	18	156
	2	0825	30.0	32.9	25.0	79	350
	3	0855	30.0	32.6	25.3	156	115
	4	0930	30.0	32.2	26.2	49	163
	5	1015	30.0	30.9	27.6	0	199
	6	1045	30.0	30.0	28.3	0	140
8/20/57	1	0853	30.0	31.4	20.5	0	127
	2	0930	30.0	31.2	20.8	587	179
	3	1100	30.0	30.9	21.5	327	129
	4	1120	30.0	30.4	21.6	37	125
	5	1155	30.0	22.5	21.8	235	222
	6	1215	30.0	26.0	22.2	4	65
8/26/57	1	0810	30.0	31.4	22.4	0	102
	2	0825	30.0	30.6	22.3	0	105
	3	0845	30.0	31.2	22.7	0	129
	4	0905	30.0	30.4	22.9	235	301
	5	0940	30.0	29.5	22.9	5	73
	6	0955	30.0	28.9	23.1	6	101
	7	1015	30.0	28.5	23.3	0	43
	8	1030	30.0	27.0	23.3	21	22
8/30/57	1	0825	30.0	31.0	23.3	0	133
	2	0845	30.0	31.2	23.4	223	186
	3	0910	30.0	30.6	23.8	0	165
	4	0930	30.0	29.6	24.3	0	214
	5	0950	30.0	28.0	24.5	0	328
	6	1005	30.0	26.7	25.0	32	303
	7	1030	30.0	26.2	25.3	4	567
9/3/57	1	0845	30.0	30.6	25.9	0	182
	2	0905	30.0	30.5	25.8	324	107
	3	0930	30.0	30.2	26.2	0	94
	4	0950	30.0	29.0	26.6	32	113
	5	1020	30.0	26.4	27.1	109	237
	6	1040	30.0	22.8	28.1	532	384
	7	1110	30.0	17.7	29.7	9	795
9/6/57	1	0915	30.0	32.2	23.9	0	492
	2	0945	30.0	31.9	24.2	0	77
	3	1005	30.0	31.4	24.6	0	192
	4	1030	30.0	30.6	24.8	114	124
	5	1100	30.0	27.7	24.6	829	436
	6	1130	30.0	27.0	25.1	28	389
	7	1155	30.0	25.3	25.2	17	247
9/9/57	1	0935	30.0	30.7	22.9	0	348
	2	0950	30.0	31.2	22.8	0	11
	3	1010	30.0	31.2	22.9	0	122
	4	1030	30.0	30.1	23.0	1	307
	5	1045	30.0	29.7	23.1	17	98
	6	1100	30.0	28.1	23.1	99	59
	7	1126	30.0	26.3	23.2	10	82
	8	1140	30.0	24.2	23.1	58	82
9/11/57	1	0900	30.0	31.0	23.1	0	137
	2	0920	30.0	30.8	23.6	0	134
	3	0940	30.0	30.8	23.7	0	198
	4	0955	30.0	29.3	24.0	35	124
	5	1015	30.0	28.8	24.4	7	161
	6	1035	30.0	27.9	25.1	92	98
	7	1055	30.0	26.0	25.8	46	87
	8	1115	30.0	25.3	25.1	18	68
9/13/57	1	0830	30.0	30.8	25.5	0	121
	2	0950	30.0	30.5	25.8	457	80
	3	0920	30.0	30.2	26.1	656	154
	4	0950	30.0	29.3	27.0	17	153
	5	1020	30.0	27.6	27.4	39	102
	6	1035	30.0	28.5	27.8	198	237
	7	1055	30.0	27.3	28.0	63	71
	8	1115	30.0	25.8	28.6	67	17
9/16/57	1	0900	30.0	30.9	26.7	0	167
	2	0925	30.0	30.6	26.0	1,445	18
	3	1010	30.0	30.1	26.9	0	162
	4	1030	30.0	28.8	27.2	62	245
	5	1100	30.0	27.6	27.7	88	435
	6	1125	30.0	26.8	28.2	188	306
	7	1150	30.0	26.0	28.8	79	261
	8	1225	30.0	23.6	29.9	391	127
9/18/57	1	0840	30.0	31.2	22.2	0	82
	2	0855	30.0	31.2	22.6	0	64
	3	0915	30.0	30.4	23.3	0	140
	4	0935	30.0	29.6	23.0	360	456
	5	1010	30.0	28.4	22.7	337	67
	6	1025	30.0	26.3	22.8	100	68
	7	1045	30.0	25.3	23.0	8	212
	8	1100	30.0	21.3	23.1	10	194
9/20/57	1	0905	30.0	31.5	22.6	0	354
	2	0925	30.0	31.5	22.6	0	117
	3	0945	30.0	31.0	23.1	158	116
	4	1005	30.0	30.5	23.7	51	192
	5	1045	30.0	26.6	23.6	489	206
	6	1105	30.0	24.9	23.8	0	195
	7	1120	30.0	23.2	25.1	0	310
	8	1135	30.0	20.1	24.1	0	486
9/23/57	1	0920	30.0	31.7	24.1	0	47
	2	0940	30.0	31.2	24.4	202	62
	3	1010	30.0	31.0	24.4	0	920
	4	1025	30.0	30.2	24.6	110	298
	5	1105	30.0	28.9	24.7	24	112
	6	1125	30.0	26.6	24.7	37	110
	7	1150	30.0	26.2	25.1	5	118
	8	1210	30.0	24.3	24.6	0	210
9/25/57	1	0920	30.0	32.1	20.0	0	1,022
	2	0935	30.0	31.8	19.9	0	17
	3	0950	30.0	31.4	20.5	0	342
	4	1005	30.0	30.9	20.5	61	148
	5	1035	30.0	30.1	20.7	0	141
	6	1045	30.0	30.0	21.1	1	29
	7	1100	30.0	28.8	21.1	0	21
	8	1115	30.0	28.5	21.2	286	12
9/27/57	1	0855	30.0	32.2	16.4	0	16
	2	0915	30.0	31.7	16.1	0	606
	3	0935	30.0	31.4	17.0	0	338
	4	0950	30.0	31.2	16.6	0	71
	5	1015	30.0	30.4	16.6	0	91
	6	1025	30.0	29.8	16.5	0	25
	7	1035	30.0	29.6	16.5	9	23
	8	1055	30.0	29.3	16.5	8	11
10/2/57	1	0950	30.0	30.9	17.1	0	42
	2	1005	30.0	30.9	17.1	0	220
	3	1025	30.0	30.4	17.3	0	138
	4	1050	30.0	29.7	17.6	0	155
	5	1120	30.0	26.4	18.1	0	225
	6	1140	30.0	23.6	18.3	1,562	95
	7	1220	30.0	23.2	20.9	0	692
	8	1250	30.0	16.4	21.6	66	150

Appendix table 1.--Continued

Date	Station	Time	Seine length	Salinity	Temperature	Menhaden	Other fishes
		E.s.t.	M.	P.p.t.	°C.	Number	Number
10/4/57	1	1005	30.0	31.4	15.8	0	74
	2	1035	30.0	31.2	16.1	0	37
	3	1050	30.0	30.9	16.5	0	238
	4	1110	30.0	30.1	16.4	0	190
	5	1135	30.0	29.5	16.7	0	40
	6	1150	30.0	27.2	16.5	1	154
	7	1205	30.0	25.9	16.7	0	98
	8	1220	30.0	22.2	16.4	0	159
10/7/57	1	1140	30.0	30.8	17.2	0	209
	2	1155	30.0	30.5	17.4	--	--
	3	1200	30.0	30.5	17.0	0	58
	4	1215	30.0	30.0	17.3	0	13
	5	1235	30.0	28.9	17.8	--	--
	6	1240	30.0	28.0	17.8	--	--
	7	1245	30.0	27.1	17.8	--	--
	8	1246	30.0	25.6	18.2	--	--
10/9/57	1	0935	30.0	31.0	16.8	0	63
	2	0950	30.0	30.5	17.0	0	7
	3	1010	30.0	30.4	17.1	0	39
	4	1030	30.0	29.6	17.4	0	138
	5	1055	30.0	29.5	17.8	0	63
	6	1110	30.0	28.8	18.2	0	48
	7	1125	30.0	27.7	18.2	0	355
	8	1140	30.0	28.0	18.5	65	112
10/11/57	1	1025	30.0	31.2	15.8	0	453
	2	1055	30.0	30.6	15.8	--	--
	3	1105	30.0	30.8	16.3	0	85
	4	1120	30.0	30.0	16.5	0	124
	5	1145	30.0	29.7	16.7	0	153
	6	1200	30.0	29.5	16.8	--	--
	7	1210	30.0	27.9	16.8	0	55
	8	1225	30.0	28.4	17.0	1	12
10/14/57	1	1015	30.0	30.5	12.4	0	65
	2	1035	30.0	30.5	13.5	0	146
	3	1100	30.0	30.4	14.0	0	309
	4	1125	30.0	29.3	14.0	0	419
	5	1150	30.0	28.3	14.5	0	367
	6	1205	30.0	27.7	14.8	0	37
	7	1240	30.0	27.5	15.3	0	40
	8	1255	30.0	26.2	15.4	39	416
10/16/57	1	1120	30.0	30.4	14.9	0	42
	2	1140	30.0	30.4	15.1	0	780
	3	1200	30.0	30.1	15.4	0	378
	4	1225	30.0	29.3	15.8	0	41
	5	1250	30.0	27.9	16.7	0	252
	6	1305	30.0	26.6	17.9	291	42
	7	1330	30.0	23.8	18.1	41	121
10/18/57	1	1115	30.0	30.1	16.7	0	106
	2	1140	30.0	29.8	16.9	0	47
	3	1155	30.0	29.1	17.2	0	56
	4	1210	30.0	28.4	17.3	490	74
	5	1255	30.0	26.8	18.2	0	208
	6	1310	30.0	24.5	18.8	1,350	70
	7	1335	30.0	24.2	19.5	1,636	114
10/21/57	1	1025	30.0	30.6	12.4	0	100
	2	1040	30.0	30.1	11.8	0	249
	3	1105	30.0	29.8	12.5	0	31
	4	1130	30.0	28.8	12.8	0	14
	5	1210	30.0	26.8	13.1	0	93
	6	1225	30.0	26.0	13.2	0	79
	7	1250	30.0	23.8	13.8	35	342
	8	1310	30.0	19.6	13.6	0	97
10/23/57	1	1130	30.0	30.4	14.5	0	127
	2	1150	30.0	30.1	14.6	0	340
	3	1215	30.0	29.3	15.0	0	114
	4	1235	30.0	29.6	15.1	0	234
	5	1310	30.0	27.3	16.1	0	115
	6	1325	30.0	26.8	16.3	3	195
	7	1345	30.0	25.5	16.6	1	233
	8	1410	30.0	21.5	16.0	15	134
10/25/57	1	1145	30.0	30.4	--	0	233
	2	1125	30.0	29.7	14.8	--	--
	3	1110	30.0	29.7	15.1	0	24
	4	1040	30.0	28.0	15.4	0	79
	5	1025	30.0	28.0	15.1	0	46
	6	1005	30.0	27.1	15.2	0	117
	7	0950	30.0	25.9	15.1	0	55
	8	0935	30.0	24.6	15.2	5	25
10/28/57	1	1310	30.0	30.9	8.4	0	884
	2	1320	30.0	30.6	8.1	--	--
	3	1250	30.0	30.6	8.4	0	155
	4	1215	30.0	29.8	8.6	0	22
	5	1200	30.0	28.0	8.5	0	26
	6	1145	30.0	27.7	8.6	0	211
	7	1130	30.0	27.0	8.3	0	97
	8	1115	30.0	25.9	8.0	0	185
11/14/57	1	1020	30.0	28.2	9.7	0	183
	2	1045	30.0	27.2	9.9	0	116
	3	1110	30.0	27.0	9.4	1	243
	4	1130	30.0	26.2	9.9	0	283
	5	1155	30.0	27.5	10.0	2	194
	6	1210	30.0	21.5	11.5	0	627
	7	1230	30.0	22.0	11.7	0	160
	8	1245	30.0	19.9	12.5	0	307
11/19/57	1	1110	30.0	--	14.7	0	70
	2	1125	30.0	27.7	15.5	--	--
	3	1130	30.0	27.0	15.6	0	104
	4	1150	30.0	25.9	15.5	0	199
	5	1220	30.0	24.1	16.0	0	199
	6	1230	30.0	20.4	16.0	0	488
	7	1245	30.0	17.4	16.5	1	762
	8	1300	30.0	13.4	16.4	0	307
11/22/57	1	1025	30.0	30.1	10.2	0	131
	2	1045	30.0	28.3	10.5	0	547
	3	1105	30.0	27.6	10.4	0	29
	4	1120	30.0	26.0	10.6	0	709
	5	1210	30.0	23.9	10.7	0	1,501
	6	1220	30.0	23.7	10.6	0	527
	7	1240	30.0	22.5	10.8	0	1,548
	8	1255	30.0	19.9	10.2	0	291
11/26/57	1	1355	30.0	29.5	6.5	0	174
	2	1340	30.0	27.1	6.6	--	--
	3	1330	30.0	27.0	7.2	0	6
	4	1230	30.0	25.8	7.2	0	0
	5	1215	30.0	21.6	6.3	0	751
	6	1200	30.0	23.4	6.8	0	262
	7	1145	30.0	17.5	6.3	0	1
	8	1130	30.0	18.6	6.5	0	1,774
12/2/57	1	1040	30.0	26.3	5.5	0	1
	2	1105	30.0	24.7	6.6	0	52
	3	1135	30.0	20.7	5.4	0	96
	4	1200	30.0	23.3	7.4	0	355
12/6/57	1	1040	30.0	29.7	3.5	0	2
	2	1105	30.0	24.5	1.7	--	--
	3	1110	30.0	25.5	2.4	--	--
	4	1120	30.0	26.6	3.3	0	0
	5	1155	30.0	23.9	3.6	0	5
	6	1205	30.0	22.1	3.5	--	--
	7	1225	30.0	18.1	3.3	--	--
	8	1235	30.0	15.2	3.2	0	73
12/17/57	1	1040	30.0	26.8	4.9	0	10
	2	1115	30.0	26.6	5.5	0	111
	3	1140	30.0	23.9	5.2	0	29
	4	1230	30.0	14.7	5.6	0	144
	5	1345	30.0	3.6	6.5	0	50
	6	1505	30.0	2.7	7.7	0	195
12/27/57	1	1110	30.0	26.8	7.5	0	3
	2	1135	30.0	21.1	7.4	0	13
	3	1150	30.0	22.6	7.9	0	41
	4	1205	30.0	13.2	7.2	0	25
	5	1220	30.0	9.5	7.8	0	142
	6	1235	30.0	7.5	8.3	1	120
	7	1250	30.0	4.9	8.6	2	610
	8	1300	30.0	0.8	9.1	0	122
12/30/57	1	1530	30.0	25.4	6.9	29	1
	2	1510	30.0	26.4	7.4	0	8
	3	1450	30.0	23.8	7.1	0	4
	4	1435	30.0	20.3	7.8	1	501
	5	1415	30.0	9.7	6.7	2	19
	6	1210	30.0	4.2	6.0	3	19
	7	1200	30.0	1.4	6.4	2	574
	8	1145	30.0	0.4	6.3	0	606

Appendix table 1.--Continued

Date	Station	Time	Seine length	Salinity	Temperature	Menhaden	Other fishes
		E.s.t.	M.	P.p.t.	°C.	Number	Number
1/2/58	1	1315	30.0	26.6	4.4	0	2
	2	1255	30.0	22.5	3.2	5	12
	3	--	30.0	22.4	--	14	13
	4	1150	30.0	19.0	4.0	0	11
	5	1135	30.0	12.2	4.1	0	160
	6	1115	30.0	4.9	3.3	3	20
	7	1055	30.0	11.5	4.9	0	223
	8	1035	30.0	3.0	3.4	0	5,049
1/20/58	1	1135	30.0	19.4	0.1	--	--
	2	1150	30.0	16.2	0.0	--	--
	3	1210	30.0	12.2	1.9	--	--
	4	1345	30.0	6.2	1.5	--	--
	5	1220	30.0	4.5	1.4	--	--
	6	1305	30.0	3.2	1.1	--	--
	7	1300	30.0	3.3	1.2	--	--
	8	1240	30.0	2.0	1.4	--	--
1/23/58	1	1020	30.0	26.8	3.2	0	0
	2	1035	30.0	22.5	3.2	0	2
	3	1050	30.0	22.9	3.2	0	2
	4	1110	30.0	17.0	2.9	0	3
	5	1145	30.0	10.0	3.7	0	18
	6	1200	30.0	11.6	4.1	0	35
	7	1215	30.0	7.6	5.3	0	250
	8	1230	30.0	0.8	6.6	1	314
1/27/58	1	1045	30.0	23.4	4.0	0	3
	2	1105	30.0	20.0	4.2	1	3
	3	1125	30.0	10.2	4.1	0	4
	4	1145	30.0	7.7	4.6	0	0
	5	1225	30.0	6.7	5.4	0	0
	6	1240	30.0	5.5	5.7	0	0
	7	1255	30.0	1.9	6.2	0	1
	8	1300	30.0	1.0	6.3	0	354
1/30/58	1	1015	30.0	22.8	3.8	0	0
	2	1040	30.0	22.5	4.6	0	4
	3	1055	30.0	11.8	3.9	0	3
	4	1115	30.0	6.9	4.3	0	61
	5	1215	30.0	5.8	5.3	0	8
	6	1230	30.0	3.0	5.3	0	10
	7	1240	30.0	0.8	5.8	1	17
	8	1255	30.0	0.2	6.0	1	83
2/3/58	1	1150	30.0	24.5	1.6	--	--
	2	1200	30.0	23.0	1.7	--	--
	3	1215	30.0	17.3	1.4	--	--
	4	1305	30.0	15.4	2.1	--	--
	5	1225	30.0	13.8	2.3	--	--
	6	1252	30.0	8.7	2.7	--	--
	7	1250	30.0	6.8	2.9	--	--
	8	1240	30.0	3.0	2.9	--	--
2/6/58	1	1320	30.0	11.1	3.7	0	0
	2	1250	30.0	18.1	3.0	0	2
	3	1235	30.0	15.4	3.3	0	1
	4	1155	30.0	7.7	3.7	0	0
	5	1135	30.0	5.5	3.8	0	4
	6	1120	30.0	5.2	3.4	0	64
	7	1105	30.0	3.3	3.8	0	10
	8	1050	30.0	3.2	3.3	0	111
2/13/58	1	1025	30.0	25.6	0.6	--	--
	2	1040	30.0	10.1	0.7	--	--
	3	1055	30.0	10.6	0.8	--	--
	4	1145	30.0	4.5	0.5	--	--
	5	1110	30.0	3.7	0.3	--	--
	6	1135	30.0	3.6	0.6	--	--
	7	1130	30.0	2.4	0.7	--	--
	8	1120	30.0	0.8	0.5	--	--
2/21/58	1	1100	30.0	22.0	0.2	--	--
	2	1110	30.0	21.1	0.7	--	--
	3	1130	30.0	8.2	0.5	--	--
	4	1255	30.0	3.2	0.7	--	--
	5	1145	30.0	4.1	1.1	--	--
	6	1235	30.0	3.8	1.8	--	--
	7	1230	30.0	3.0	2.4	--	--
	8	1200	30.0	1.8	1.6	--	--
2/25/58	1	1010	30.0	23.9	2.2	--	--
	2	1020	30.0	9.2	1.7	--	--
	3	1035	30.0	14.1	1.8	--	--
	4	1155	30.0	16.9	3.9	--	--
	5	1050	30.0	16.7	5.9	--	--
	6	1135	30.0	20.5	6.7	--	--
	7	1125	30.0	15.8	7.4	--	--
	8	1105	30.0	9.2	7.7	--	--
2/28/58	1	1120	30.0	24.7	5.3	--	--
	2	1110	30.0	21.6	6.5	--	--
	3	1055	30.0	18.6	6.7	--	--
	4	0925	30.0	19.6	5.8	--	--
	5	0920	30.0	8.2	6.3	--	--
	6	0915	30.0	3.6	6.4	--	--
	7	0910	30.0	1.6	6.5	--	--
	8	0905	30.0	0.8	6.5	--	--
3/5/58	1	1200	30.0	25.0	5.6	--	--
	2	1212	30.0	24.5	5.8	--	--
	3	1230	30.0	21.1	6.4	--	--
	4	1110	30.0	17.9	6.2	0	3
	5	1100	30.0	15.6	6.8	--	--
	6	1050	30.0	15.0	6.6	0	443
	7	1045	30.0	13.2	6.7	--	--
	8	1035	30.0	10.4	6.8	0	583
3/7/58	1	1135	30.0	24.3	5.8	0	1
	2	1110	30.0	22.8	6.3	0	7
	3	1050	30.0	22.2	6.5	0	2
	4	1015	30.0	19.4	6.8	0	0
	5	1000	30.0	16.2	6.4	0	3
	6	0945	30.0	14.5	6.5	0	131
	7	0930	30.0	11.8	6.4	0	22
	8	0915	30.0	11.5	6.6	0	31
3/11/58	1	1045	30.0	23.6	6.0	--	--
	2	1055	30.0	22.5	6.5	--	--
	3	1100	30.0	21.1	7.0	--	--
	4	1110	30.0	13.6	5.9	--	--
	5	1122	30.0	8.3	7.1	--	--
	6	1130	30.0	2.8	7.3	--	--
	7	1135	30.0	4.5	8.1	--	--
	8	1142	30.0	2.0	8.9	--	--
3/13/58	1	1425	30.0	22.2	5.5	--	--
	2	1410	30.0	20.0	6.0	--	--
	3	1405	30.0	14.8	5.4	--	--
	4	1330	30.0	12.2	5.9	0	2
	5	1315	30.0	8.6	6.0	0	10
	6	1300	30.0	4.5	5.4	0	285
	7	1235	30.0	3.6	6.4	0	197
	8	1240	30.0	1.2	6.6	0	498
3/18/58	1	1119	30.0	21.2	5.7	--	--
	2	1114	30.0	22.5	6.4	--	--
	3	1106	30.0	22.0	6.2	--	--
	4	1044	30.0	15.8	5.9	--	--
	5	1040	30.0	13.1	6.7	--	--
	6	1033	30.0	12.7	7.4	--	--
	7	1027	30.0	10.8	7.3	--	--
	8	1020	30.0	8.8	6.4	--	--
3/24/58	1	1300	30.0	18.8	8.1	0	9
	2	1055	30.0	18.1	8.1	0	8
	3	1230	30.0	8.8	8.3	0	1
	4	1100	30.0	6.0	7.8	0	27
	5	1050	30.0	3.7	8.0	0	6
	6	1025	30.0	2.2	7.9	0	2
	7	1005	30.0	1.6	6.8	0	14
	8	0955	30.0	1.4	7.2	0	41
4/2/58	1	1131	30.0	24.1	7.9	--	--
	2	1116	30.0	21.9	8.3	--	--
	3	1112	30.0	21.3	7.8	--	--
	4	1052	30.0	9.0	8.5	--	--
	5	1049	30.0	8.2	8.8	--	--
	6	1047	30.0	6.4	8.8	--	--
	7	1044	30.0	7.2	9.2	--	--
	8	1040	30.0	4.1	8.0	--	--
4/4/58	1	1049	30.0	13.6	9.8	--	--
	2	1045	30.0	15.5	10.4	--	--
	3	1041	30.0	15.1	10.5	--	--
	4	1028	30.0	14.8	11.0	--	--
	5	1025	30.0	11.4	11.3	--	--
	6	1023	30.0	10.0	11.8	--	--
	7	1020	30.0	10.2	12.1	--	--
	8	1018	30.0	5.9	11.3	--	--
4/7/58	1	--	--	--	--	--	--
	2	1255	30.0	23.4	11.6	--	--
	3	1245	30.0	22.6	11.7	--	--
	4	1150	30.0	15.2	13.3	0	7
	5	1145	30.0	10.8	13.5	--	--
	6	1120	30.0	12.2	12.9	0	140
	7	1115	30.0	10.2	13.1	--	--
	8	1050	30.0	7.8	13.2	0	1,044

Appendix table 1.--Continued

Date	Station	Time	Seine length	Salinity	Temperature	Menhaden	Other fishes	Date	Station	Time	Seine length	Salinity	Temperature	Menhaden	Other fishes
		E.s.t.	M.	P.p.t.	°C.	Number	Number			E.s.t.	M.	P.p.t.	°C.	Number	Number
4/10/58	1	1040	30.0	17.5	10.1	0	5	5/20/58	1	1215	30.0	21.7	19.7	0	712
	2	1050	30.0	17.8	10.7	0	56		2	1150	30.0	22.9	20.1	0	695
	3	1115	30.0	10.9	10.6	0	77		3	1140	30.0	18.2	20.6	0	810
	4	1130	30.0	8.0	10.7	0	67		4	1105	30.0	12.9	21.1	1	534
	5	1205	30.0	5.5	10.9	0	103		5	1050	30.0	12.7	21.3	1,300	299
	6	1220	30.0	2.6	10.6	0	46		6	1040	30.0	11.0	21.3	425	678
	7	1235	30.0	2.0	10.9	0	16		7	1025	30.0	8.4	21.2	300	931
	8	1255	30.0	1.2	12.7	0	474		8	1015	30.0	5.9	20.8	0	1,510
4/14/58	1	1240	30.0	19.6	12.9	0	2	5/27/58	1	1205	7.5	25.9	18.7	0	39
	2	1215	30.0	13.6	13.3	0	48		2	1140	7.5	23.9	18.9	0	62
	3	1145	30.0	9.1	12.9	0	29		3	1135	7.5	22.6	19.7	0	2
	4	1045	30.0	5.4	12.8	0	194		4	1110	7.5	16.2	19.1	0	87
	5	1025	30.0	3.8	12.9	1	330		5	1100	7.5	6.9	18.3	215	26
	6	1010	30.0	1.4	12.1	1	454		6	1055	7.5	2.6	18.5	0	25
	7	0955	30.0	0.6	11.5	0	87		7	1050	7.5	1.3	19.0	3	35
	8	0940	30.0	0.4	11.1	0	3		8	1045	7.5	0.6	18.7	0	15
4/17/58	1	1020	30.0	23.4	11.8	0	6	5/29/58	1	0930	7.5	26.2	17.9	0	1
	2	1035	30.0	23.3	12.8	0	28		2	0940	7.5	24.3	18.1	0	39
	3	1100	30.0	22.8	13.6	0	5		3	0945	7.5	24.3	18.9	0	3
	4	1120	30.0	20.0	13.5	0	320		4	0955	7.5	22.5	19.3	0	4-8
	5	1205	30.0	9.5	15.1	0	326		5	1015	7.5	17.0	19.9	2	45-19
	6	1220	30.0	5.6	15.3	6	365		6	1025	7.5	12.7	20.1	0	8-29
	7	1230	30.0	2.8	15.9	3	459		7	1040	7.5	9.0	20.6	21	16-29
	8	1245	30.0	0.6	15.4	0	78		8	1050	7.5	2.8	20.1	0	6-15
4/21/58	1	1315	30.0	25.4	16.6	0	37	6/2/58	1	1130	7.5	23.3	21.6	0	3
	2	1305	30.0	22.0	19.6	0	123		2	1110	7.5	18.3	23.2	1	36
	3	1235	30.0	18.8	18.8	0	133		3	1100	7.5	16.8	23.1	0	12
	4	1155	30.0	15.9	19.2	2	87		4	1020	7.5	14.8	22.6	25	33-28
	5	1140	30.0	16.7	19.7	0	266		5	1005	7.5	15.1	22.7	12	31-14
	6	1120	30.0	16.9	19.8	9	155		6	0955	7.5	13.7	22.8	28	34-14
	7	1105	30.0	10.2	20.3	27	303		7	0945	7.5	13.3	22.7	2	38-31
	8	1040	30.0	4.0	19.3	0	644		8	0925	7.5	7.8	22.8	15	64-38
4/24/58	1	1100	30.0	24.9	16.2	0	12	6/5/58	1	--	30.0	--	--	--	--
	2	1045	30.0	20.7	16.5	0	245		2	--	--	--	--	--	--
	3	1035	30.0	20.3	16.8	0	182		3	--	--	--	--	--	--
	4	0950	30.0	18.2	17.5	0	100		4	1355	30.0	21.5	22.7	134	433
	5	0940	30.0	12.3	17.8	0	652		5	1405	30.0	15.8	24.2	130	687
	6	0930	30.0	7.0	17.0	30	379		6	1420	30.0	11.9	24.3	124	339
	7	0915	30.0	5.1	17.0	0	411		7	1500	30.0	9.0	25.3	5	397
	8	0900	30.0	1.0	15.4	0	368		8	1530	30.0	7.0	24.9	0	1,242
4/29/58	1	1145	30.0	21.2	18.2	0	129	6/6/58	1	1125	7.5	27.3	20.2	0	13
	2	1120	30.0	19.2	17.8	0	293		2	1115	7.5	24.2	21.3	0	53
	3	1105	30.0	18.6	18.2	0	406		3	1105	7.5	24.1	21.6	7	84
	4	1015	30.0	19.0	17.0	0	224		4	1050	7.5	18.8	21.9	0	36
	5	1000	30.0	10.8	17.3	185	678		5	1040	7.5	18.7	22.5	4	45
	6	0950	30.0	6.3	17.4	245	570		6	1030	7.5	17.8	22.3	2	51
	7	0935	30.0	2.6	16.8	0	216		7	1025	7.5	13.6	22.7	28	13
	8	0925	30.0	0.8	16.3	0	988		8	1015	7.5	8.8	22.5	0	39
5/1/58	1	0945	7.5	20.3	14.4	0	15	6/9/58	1	0820	30.0	23.4	22.1	0	218
	2	0935	7.5	16.5	14.6	0	79		2	0835	30.0	21.5	22.3	43	633
	3	0930	7.5	16.4	15.8	0	0		3	0915	30.0	18.8	22.6	6	247
	4	0920	7.5	17.9	17.5	0	7		4	0935	30.0	19.5	23.4	305	248
	5	0910	7.5	8.3	16.5	1	3		5	1020	7.5	14.2	25.6	63	63
	6	0905	7.5	10.5	16.4	0	88		6	1030	7.5	9.2	26.3	42	77
	7	0900	7.5	2.7	15.2	0	124		7	1045	7.5	2.4	25.7	1	155
	8	0850	7.5	1.0	13.8	0	0		8	--	--	--	--	--	--
5/7/58	1	1051	7.5	25.9	11.7	--	--	6/11/58	1	0850	30.0	26.3	25.0	0	347
	2	1040	7.5	24.6	11.8	--	--		2	0900	30.0	22.8	26.3	38	591
	3	1035	7.5	24.1	11.9	--	--		3	0935	30.0	22.5	27.0	65	329
	4	1015	7.5	12.0	11.7	--	--		4	0955	30.0	21.1	27.3	0	124
	5	1010	7.5	4.4	11.5	--	--		5	1040	30.0	17.3	28.9	164	485
	6	1000	7.5	1.7	11.4	--	--		6	1105	30.0	13.1	29.9	25	365
	7	0955	7.5	1.3	11.4	--	--		7	1130	30.0	8.9	31.1	11	179
	8	0950	7.5	0.2	11.3	--	--		8	--	--	--	--	--	--
5/9/58	1	0955	7.5	19.9	14.4	0	9	6/13/58	1	1045	30.0	26.2	26.5	0	600
	2	0935	7.5	11.9	14.6	1	9		2	1005	30.0	21.1	26.1	36	1,015
	3	0935	7.5	11.5	14.6	0	1		3	0945	30.0	19.6	26.4	0	390
	4	0905	7.5	13.4	14.5	0	0		4	0905	30.0	20.5	26.9	25	581
	5	0900	7.5	2.7	13.6	0	15		5	0845	30.0	17.9	27.1	252	362
	6	0855	7.5	1.0	13.2	0	1		6	0830	30.0	11.6	26.1	109	494
	7	0835	7.5	0.5	13.2	20	5		7	0813	30.0	11.9	26.5	4	390
	8	0840	7.5	0.2	13.3	0	0		8	0755	30.0	7.0	25.5	0	367
5/14/58	1	1205	7.5	22.9	19.0	0	35	6/18/58	1	0835	30.0	25.4	21.0	1	309
	2	1145	7.5	21.5	19.2	0	38		2	0905	30.0	24.2	21.2	180	262
	3	1120	7.5	20.8	19.1	0	4		3	0930	30.0	22.6	22.1	0	155
	4	1055	7.5	17.9	19.8	0	58		4	0950	30.0	21.9	23.1	84	194
	5	1045	7.5	9.4	20.1	308	67		5	1020	30.0	19.5	24.2	14	277
	6	1040	7.5	3.3	18.9	0	30		6	1035	30.0	18.8	25.0	465	159
	7	1035	7.5	4.2	18.9	8	42		7	1050	30.0	17.5	25.0	597	201
	8	1030	7.5	0.5	17.2	0	25		8	1145	30.0	19.4	26.0	363	309

Appendix table 2.--Number of fish caught per seine haul, grouped by 3-month periods; White Creek, Del. (A = April--June, 1957; B = July--September, 1957; C = October--December, 1957; D = January--March, 1958; E = April--June, 1958)

Species	3-month period	Station							
		1	2	3	4	5	6	7	8
Dasyatis sayi.....	B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Elops saurus.....	C	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Alosa aestivalis.....	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
A. pseudoharengus.....	C	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
	E	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0
Brevoortia tyrannus.....	A	0.0	11.4	2.3	8.9	114.2	149.4	201.1	118.4
	B	0.0	196.4	85.3	105.1	72.9	62.0	13.4	54.3
	C	1.4	0.0	0.1	23.4	0.2	169.0	7.0	12.8
	D	0.0	0.9	2.0	0.0	0.0	0.3	0.1	0.2
	E	0.1	16.7	4.3	27.7	140.7	75.5	54.5	2.7
Anchoa hepsetus.....	B	0.0	0.0	0.2	0.3	0.2	0.1	0.0	0.0
	C	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
A. mitchilli.....	A	0.0	10.0	9.3	26.0	8.5	11.8	7.2	2.4
	B	0.0	3.5	48.0	30.6	15.0	7.1	2.4	1.1
	C	1.1	32.5	21.2	19.3	7.5	4.2	0.6	0.1
	E	1.9	2.5	6.5	17.8	25.6	21.6	1.8	0.2
Anchoviella eurystole.....	B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Umbra pygmaea.....	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Cyprinids.....	A	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
	B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	C	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Anguilla rostrata.....	A	0.1	0.6	0.7	0.2	0.1	0.5	0.6	1.0
	B	0.0	0.4	0.0	0.1	0.0	0.1	0.0	0.1
	C	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
	D	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	E	0.4	1.0	0.0	0.1	0.4	0.0	3.1	5.9
Strongylurus marina.....	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	B	0.0	0.1	0.1	0.2	0.0	0.1	0.0	0.0
	C	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Hyphorhamphus unifasciatus..	B	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Cyprinodon variegatus.....	A	0.8	1.9	1.0	0.2	8.4	9.4	3.9	3.6
	B	0.6	0.0	0.0	0.0	2.1	6.4	3.3	2.6
	C	1.6	3.4	3.0	10.3	6.9	22.4	134.7	149.6
	D	0.1	1.0	0.1	0.7	5.3	9.6	38.5	53.1
	E	1.2	0.5	0.3	3.3	6.8	7.0	11.3	35.5
Fundulus diaphanus.....	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	C	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
	D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	E	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
F. heteroclitus.....	A	13.8	59.6	16.4	27.9	50.3	28.6	36.0	22.4
	B	10.2	18.0	13.0	13.8	31.1	48.3	78.5	31.7
	C	0.6	50.2	22.0	3.1	22.7	37.2	120.2	35.7
	D	1.1	0.4	0.0	0.0	0.1	2.7	1.6	6.1
	E	70.8	137.9	77.8	43.4	90.6	89.0	217.0	271.7
F. majalis.....	A	3.4	2.4	1.2	1.5	4.1	1.8	0.9	3.6
	B	16.0	1.4	0.8	3.1	2.3	3.6	5.2	5.8
	C	3.4	6.6	3.2	0.9	5.6	9.1	5.6	11.3
	D	0.1	0.0	1.0	0.2	0.6	1.0	0.4	4.1
	E	17.1	13.1	0.9	6.0	8.7	7.5	1.2	1.2
Lucania parva.....	A	0.1	0.8	1.9	1.2	1.5	1.0	0.7	0.2
	B	1.1	55.6	0.4	0.1	0.1	0.5	0.4	1.6
	C	0.2	7.2	0.4	0.4	0.6	1.8	4.2	17.7
	D	0.4	1.1	0.1	0.0	0.1	0.7	3.6	12.2
	E	8.2	27.0	0.3	0.7	1.5	0.9	1.5	1.3

Appendix table 2.--Continued

Species	3-month period	Station							
		1	2	3	4	5	6	7	8
Gambusia affinis.....	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Pollachius virens.....	D	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
	E	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Apeltes quadracus.....	A	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
	B	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0
	C	0.1	1.6	0.2	0.1	0.1	0.0	0.0	0.1
	D	0.1	1.1	0.3	0.0	0.3	0.1	0.0	0.3
	E	1.1	3.6	0.5	0.3	0.6	0.3	0.2	0.1
Gasterosteus aculeatus.....	A	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
	E	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Hippocampus erectus.....	C	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Syngnathus fuscus.....	A	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
	B	0.0	0.6	0.2	0.0	0.0	0.0	0.0	0.0
	C	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0
	E	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Roccus americanus.....	E	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.0
Pomatomus saltatrix.....	A	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
	B	0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.0
	E	0.2	0.1	0.3	0.2	0.2	0.4	0.0	0.0
Caranx crysos.....	C	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
C. hippos.....	B	0.0	0.0	0.4	0.1	0.1	0.0	0.0	0.0
	C	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Decapterus punctatus.....	B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trachinotus falcatus.....	B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eucinostomus argenteus.....	B	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
	C	0.3	0.4	0.0	0.1	0.1	0.0	0.0	0.0
Orthopristis chrysopterus...	B	0.5	0.0	0.1	0.0	0.0	0.0	0.0	0.0
	C	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Bairdiella chrysura.....	B	0.1	13.1	3.4	9.6	8.8	4.5	5.8	0.8
	C	0.1	0.1	0.2	0.1	1.1	2.0	1.7	0.3
	E	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Cynoscion nebulosus.....	B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leiostomus xanthurus.....	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	B	0.1	0.1	0.1	0.8	0.3	0.1	0.0	0.0
Menticirrhus saxatilis.....	B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Micropogon undulatus.....	C	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.0
	D	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Pogonias cromis.....	B	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.1
	C	0.0	0.0	0.0	0.1	0.2	0.4	0.0	0.0
Gobiosoma bosci.....	A	0.0	0.0	0.0	0.1	0.2	0.3	0.3	0.1
	B	0.2	3.9	2.7	2.5	1.2	0.6	1.0	0.2
	C	0.1	2.5	2.3	0.5	0.8	0.3	1.9	0.1
	D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	E	0.4	0.6	1.8	2.3	2.2	1.2	1.5	0.5
G. ginsburgi.....	B	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
	C	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Microgobius thallasinus.....	A	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
	B	0.0	2.1	4.2	5.8	8.6	5.2	2.7	0.1
	C	0.1	0.4	0.2	0.1	0.6	0.3	1.1	0.1
	E	0.0	0.2	0.2	2.0	2.1	1.1	0.2	0.0
Prionotus carolinus.....	C	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0

Appendix table 2.--Continued

Species	3-month period	Station							
		1	2	3	4	5	6	7	8
P. evolans	B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Astroscopus guttatus	C	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chasmodes bosquianus	C	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
	D	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0
	E	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Mugil cephalus	A	0.1	0.6	0.0	0.1	1.9	2.2	0.7	0.1
	B	0.4	0.2	0.0	0.3	0.4	0.2	0.2	0.1
	C	0.2	0.1	1.3	0.8	0.4	0.4	0.3	0.0
	D	0.0	1.1	0.6	1.0	0.1	0.0	0.3	0.0
	E	1.4	6.1	29.2	36.3	37.3	22.7	4.5	5.7
M. curema	A	0.2	0.0	0.9	0.4	0.0	2.7	0.0	0.0
	B	3.5	0.9	2.1	4.5	3.1	3.5	1.0	0.6
	C	0.1	1.3	0.4	1.1	0.5	0.4	1.4	0.4
	E	9.4	0.0	1.3	4.8	4.2	0.3	1.3	3.3
Membra martinica	B	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0
Menidia beryllina	A	13.4	30.1	57.7	45.9	63.6	69.7	24.8	48.0
	B	2.8	10.3	10.0	3.8	25.5	24.2	35.0	50.7
	C	2.2	21.9	5.4	16.6	31.7	26.1	41.1	60.8
	D	0.0	0.0	0.3	0.0	0.3	6.9	6.1	174.3
	E	14.6	39.4	21.7	35.3	37.4	50.0	40.8	41.2
M. menidia	A	24.7	2.6	2.2	1.7	0.8	0.7	0.1	0.3
	B	116.0	37.7	61.6	54.3	31.0	17.0	9.8	3.3
	C	125.3	61.9	48.4	123.6	38.8	112.8	93.6	28.5
	D	0.1	0.4	1.0	9.8	19.4	88.9	40.9	534.3
	E	9.5	6.9	16.3	20.7	29.4	23.9	8.2	40.3
Paralichthys dentatus	A	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
	B	0.0	0.2	0.3	0.1	0.1	0.5	0.0	0.0
	C	0.1	0.1	0.0	0.1	0.2	0.1	0.3	0.0
	E	0.1	0.0	0.2	0.5	0.5	0.2	0.0	0.0
Pseudopleuronectes americanus	B	2.0	0.1	0.5	0.0	0.0	0.0	0.0	0.0
	C	1.2	0.4	0.5	0.1	0.0	0.0	0.0	0.0
	D	0.0	0.0	0.3	0.1	0.0	0.1	0.0	0.0
	E	1.4	0.1	1.9	0.3	0.2	0.0	0.0	0.0
Trinectes maculatus	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	C	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
Symphurus plagiusa	B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphaeroides maculatus	B	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Opsanus tau	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	B	0.5	2.6	1.3	1.3	0.4	0.1	0.2	0.0
	C	0.1	0.1	0.2	0.1	0.2	0.0	0.0	0.0
	E	0.0	0.2	0.1	0.0	0.0	0.1	0.0	0.0

Appendix table 3.--Number and fork length ranges (mm. in parentheses) of fishes, grouped by station and by month of collection
White Creek, Del.

Species	Station								Month of collection
	1	2	3	4	5	6	7	8	
Dasyatis sayi.....	-	-	1	-	-	-	-	-	7/57
	-	-	(735)[1]	-	-	-	-	-	
Elops saurus.....	-	-	-	-	-	-	2	-	10/57
	-	-	-	-	-	-	(122-130)	-	
Alosa aestivalis.....	-	-	-	-	-	-	-	1	4/57
	-	-	-	-	-	-	-	(59)	
A. pseudoharengus.....	-	-	-	-	1	-	-	-	11/57
	-	-	-	-	(92)	-	-	-	
	-	-	-	1	1	1	-	-	4/58
	-	-	-	(89)	(263)	(240)	-	-	
	-	-	-	-	-	1	-	-	6/58
	-	-	-	-	-	(102)	-	-	
Brevoortia tyrannus.....	-	-	-	-	179	145	5	-	4/57
	-	-	-	-	(24-33)	(23-44)	(26-36)	-	
	-	3	55	247	3,121	4,071	5,279	921	5/57
	-	(28-30)	(27-33)	(26-43)	(23-59)	(22-60)	(25-54)	(26-42)	
	-	339	12	11	126	267	146	736	6/57
	-	(32-62)	(32-48)	(33-52)	(29-51)	(28-57)	(28-55)	(26-54)	
	-	1	1,351	1,157	363	351	9	9	7/57
	-	(123)	(48-98)	(50-108)	(51-81)	(39-116)	(51-68)	(48-55)	
	-	907	551	714	322	76	8	21	8/57
	-	(75-131)	(74-128)	(61-123)	(67-133)	(74-116)	(70-108)	(87-128)	
	-	4,983	656	1,281	1,502	1,432	290	838	9/57
	-	(92-145)	(94-121)	(73-128)	(68-135)	(72-140)	(68-136)	(53-137)	
	-	-	-	490	-	3,207	107	192	10/57
	-	-	-	(87-114)	-	(78-136)	(67-122)	(59-127)	
	-	-	1	-	2	-	1	-	11/57
	-	-	(27)	-	(94-113)	-	(149)	-	
	30	-	-	1	2	4	4	-	12/57
	(28-31)	-	-	(27)	(30)	(32)	(32-33)	-	
						(150-170)	(91-92)		
	-	6	14	-	-	3	1	2	1/58
	-	(26-30)	(26-30)	-	-	(93-113)	(34)	(32,104)	
	-	-	-	2	186	291	30	-	4/58
	-	-	-	(27-29)	(26-32)	(24-32)	(27-32)	-	
						(222)			
	-	1	-	1	1,826	425	352	-	5/58
	-	(29)	-	(46)	(26-54)	(33-45)	(26-51)	-	
	1	299	78	550	662	793	653	49	6/58
	(36)	(26-57)	(28-43)	(28-61)	(26-63)	(28-77)	(26-67)	(28-69)	
Anchoa hepsetus.....	-	-	1	-	-	-	-	-	7/57
	-	-	(52)	-	-	-	-	-	
	-	-	2	6	1	3	-	-	8/57
	-	-	(59-60)	(52-80)	(73)	(49-68)	-	-	
	-	-	4	2	5	1	-	-	9/57
	-	-	(67-78)	(73-76)	(61-76)	(66)	-	-	
	-	-	1	-	-	-	-	-	10/57
	-	-	(31)	-	-	-	-	-	

[1] Pectoral width

Appendix table 3.--Continued

Species	Station								Month of collection
	1	2	3	4	5	6	7	8	
A. mitchilli.....	-	96	-	500	18	149	2	-	4/57
	-	(50-89)	-	(54-85)	(47-71)	(37-90)	(51-56)	-	
	-	199	190	183	194	203	185	32	5/57
	-	(45-76)	(46-70)	(42-64)	(33-81)	(31-70)	(33-80)	(45-67)	
	-	2	80	71	42	1	6	1	6/57
	-	(53-55)	(49-68)	(47-62)	(44-75)	(60)	(48-62)	(65)	
	-	8	11	18	11	18	14	1	7/57
	-	(41-69)	(58-78)	(56-79)	(56-72)	(54-69)	(51-79)	(78)	
	2	19	8	119	52	30	2	2	8/57
	(35)	(22-52)	(28-66)	(27-90)	(25-87)	(33-82)	(63-64)	(38-73)	
	1	79	1,420	782	387	164	38	14	9/57
	(42)	(22-74)	(23-84)	(22-81)	(23-85)	(22-77)	(22-76)	(23-47)	
	21	5	421	400	66	46	3	1	10/57
	(43-59)	(56-70)	(28-58)	(25-86)	(23-59)	(24-86)	(53-76)	(51)	
	1	450	3	5	74	34	5	1	11/57
	(59)	(40-76)	(50-60)	(56-64)	(45-80)	(29-80)	(33-75)	(43)	
	-	-	-	-	2	-	1	-	12/57
	-	-	-	-	(39-44)	-	(44)	-	
	-	3	3	2	58	79	-	-	4/58
	-	(55-80)	(61-81)	(69-73)	(53-81)	(37-80)	-	-	
	4	6	6	22	72	81	1	-	5/58
	(35-60)	(55-61)	(43-63)	(47-70)	(43-65)	(45-69)	(48)	-	
	31	36	108	332	357	272	33	4	6/58
	(53-64)	(49-65)	(46-68)	(40-80)	(43-72)	(44-70)	(44-65)	(50-57)	
Anchoviella eurystole....	-	-	-	1	-	-	-	-	7/57
	-	-	-	(36)	-	-	-	-	
Umbra pygmaea.....	-	-	-	-	-	-	-	1	6/57
	-	-	-	-	-	-	-	(80)	
Cyprinids.....	-	-	-	-	-	1	1	2	4/57
	-	-	-	-	-	(48)	(44)	(38-60)	
	-	-	-	-	-	-	1	-	5/57
	-	-	-	-	-	-	(50)	-	
	-	1	-	-	-	-	-	-	8/57
	-	(20)	-	-	-	-	-	-	
	-	-	-	-	-	1	-	-	12/57
	-	-	-	-	-	(32)	-	-	
Anguilla rostrata.....	2	-	-	-	1	-	7	-	4/57
	(50-60)	-	-	-	(50)	-	(57-139)	-	
	2	3	-	2	4	2	26	1	5/57
	(57-59)	(53-62)	-	(57)	(56-300)	(56-136)	(57-200)	(64)	
	-	15	19	1	-	2	9	14	6/57
	-	(55-67)	(60-70)	(58)	-	(60-78)	(60-145)	(57-114)	
	-	4	-	-	-	2	-	2	7/57
	-	(60-450)	-	-	-	(200-350)	-	(102-124)	
	1	5	-	1	-	1	-	-	8/57
	(600)	(71-143)	-	(430)	-	(600)	-	-	
	-	2	-	1	1	-	-	-	9/57
	-	(450-600)	-	(500)	(600)	-	-	-	
	-	1	1	-	-	-	-	-	10/57
	-	(83)	(450)	-	-	-	-	-	
	-	-	-	-	-	-	-	1	12/57
	-	-	-	-	-	-	-	(78)	

Appendix table 3.--Continued

Species	Station								Month of collection
	1	2	3	4	5	6	7	8	
Anguilla rostrata--Continued	-	-	-	-	-	-	1	-	3/58
	-	-	-	-	-	-	(55)	-	
	2	5	-	-	-	7	-	4	4/58
	(56-60)	(510-580)	-	-	-	(241-600)	-	(60-190)	
	-	1	-	1	5	2	28	24	5/58
	-	(52)	-	(175)	(52-61)	(56-60)	(57-182)	(52-67)	
	5	12	-	-	3	-	31	79	6/58
	(55-96)	(52-370)	-	-	(54-360)	-	(60-168)	(58-155)	
Strongylura marina.....	-	-	1	-	-	1	-	-	6/57
	-	-	(56)	-	-	(61)	-	-	
	-	1	-	2	-	1	-	-	7/57
	-	(190)	-	(87-98)	-	(81)	-	-	
	1	1	3	4	-	1	-	-	8/57
	(145)	(134)	(155-362)	(137-310)	-	(89)	-	-	
	-	2	-	-	-	-	-	-	9/57
	-	(212-266)	-	-	-	-	-	-	
	-	-	-	1	-	-	-	-	10/57
	-	-	-	(119)	-	-	-	-	
Hyporhamphus unifasciatus.	4	1	-	-	-	-	-	-	8/57
	(103-117)	(112)	-	-	-	-	-	-	
	-	1	-	-	-	-	-	-	6/58
	-	(143)	-	-	-	-	-	-	
Cyprinodon variegatus.....	-	2	13	2	19	11	-	-	4/57
	-	(35-57)	(37-56)	(39-41)	(34-60)	(33-62)	-	-	
	17	5	11	2	112	177	57	3	5/57
	(42-62)	(42-58)	(34-55)	(43-49)	(30-65)	(35-69)	(35-63)	(52-58)	
	8	50	4	2	120	95	47	48	6/57
	(48-57)	(49-63)	(45-56)	(55-62)	(44-65)	(37-64)	(39-62)	(31-63)	
	1	-	-	-	59	145	38	16	7/57
	(60)	-	-	-	(45-68)	(47-66)	(39-63)	(34-62)	
	16	1	-	-	3	24	7	-	8/57
	(49-58)	(57)	-	-	(50-61)	(51-61)	(48-59)	-	
	-	-	-	1	-	24	30	26	9/57
	-	-	-	(37)	-	(29-63)	(34-68)	(17-60)	
	2	20	8	174	25	45	454	258	10/57
	(36-46)	(26-48)	(31-46)	(26-53)	(26-59)	(28-46)	(21-53)	(20-66)	
	23	4	8	1	24	311	1,686	1,381	11/57
	(28-42)	(22-31)	(25-56)	(30)	(25-66)	(23-59)	(24-67)	(21-72)	
	8	24	44	42	82	70	15	605	12/57
	(33-47)	(24-58)	(29-53)	(27-51)	(24-60)	(22-60)	(27-61)	(26-65)	
	-	6	1	4	32	52	249	251	1/58
	-	(36-50)	(31)	(27-33)	(23-40)	(24-42)	(22-65)	(23-62)	
	-	-	-	-	3	3	7	55	2/58
	-	-	-	-	(30-33)	(29-41)	(27-56)	(25-60)	
	1	1	-	2	7	31	52	172	3/58
	(34)	(41)	-	(35-38)	(28-32)	(25-39)	(26-65)	(27-65)	
	8	6	1	64	85	67	37	217	4/58
	(33-44)	(28-52)	(41)	(26-49)	(25-64)	(26-65)	(26-59)	(27-60)	
	6	-	2	-	18	20	53	135	5/58
	(33-53)	-	(36-47)	-	(37-62)	(31-59)	(32-64)	(29-67)	
	8	3	2	1	27	52	124	287	6/58
	(45-64)	(49-58)	(52-58)	(50)	(42-61)	(34-55)	(33-66)	(34-62)	

Appendix table 3.--Continued

Species	Station								Month of collection
	1	2	3	4	5	6	7	8	
Fundulus diaphanus.....	-	-	-	-	-	-	-	1	5/57
	-	-	-	-	-	-	-	(54)	
	-	-	-	-	-	1	-	2	6/57
	-	-	-	-	-	(78)	-	(52-62)	
	-	-	-	-	-	-	-	1	7/57
	-	-	-	-	-	-	-	(53)	
	-	-	1	-	-	-	-	-	8/57
	-	-	(90)	-	-	-	-	-	
	-	-	-	-	-	1	-	1	10/57
	-	-	-	-	-	(66)	-	(65)	
	-	-	-	-	-	-	-	1	1/58
	-	-	-	-	-	-	-	(60)	
	-	-	-	-	1	-	1	-	4/58
	-	-	-	-	(30)	-	(77)	-	
F. heteroclitus.....	5	416	96	181	317	189	53	-	4/57
	(43-76)	(36-113)	(24-96)	(45-95)	(39-106)	(28-105)	(40-90)	-	
	169	762	160	336	410	375	607	99	5/57
	(38-95)	(31-114)	(37-103)	(30-122)	(33-109)	(29-104)	(26-109)	(31-87)	
	239	611	219	292	782	294	313	214	6/57
	(40-95)	(45-113)	(44-108)	(43-114)	(45-102)	(30-109)	(38-100)	(25-90)	
	181	240	138	148	330	388	208	117	7/57
	(37-107)	(51-112)	(44-101)	(55-111)	(48-118)	(29-102)	(30-90)	(38-88)	
	105	261	179	221	421	466	501	2	8/57
	(51-114)	(25-111)	(47-106)	(53-105)	(42-110)	(43-107)	(35-100)	(75-80)	
	21	40	74	46	183	596	1,097	388	9/57
	(33-111)	(69-115)	(40-108)	(42-107)	(23-100)	(24-109)	(33-95)	(27-99)	
	5	684	338	62	173	349	863	330	10/57
	(36-96)	(19-112)	(31-120)	(44-105)	(27-122)	(32-105)	(25-110)	(30-81)	
	5	6	34	2	259	356	1,060	199	11/57
	(38-57)	(41-82)	(34-100)	(53-72)	(24-104)	(28-115)	(35-200)	(36-113)	
	2	13	68	1	-	1	-	6	12/57
	(38-46)	(35-104)	(25-97)	(50)	-	(65)	-	(39-115)	
	-	-	-	-	-	1	-	6	1/58
	-	-	-	-	-	(94)	-	(36-85)	
	-	-	-	-	-	-	-	-	2/58
	-	-	-	-	-	-	-	-	
	8	3	-	-	1	23	13	49	3/58
	(44-82)	(49-79)	-	-	(77)	(39-85)	(40-94)	(33-85)	
	61	227	275	95	931	833	2,592	2,163	4/58
	(40-102)	(37-100)	(33-96)	(32-97)	(22-107)	(31-119)	(33-102)	(26-120)	
	624	558	480	158	157	352	630	1,136	5/58
	(31-113)	(30-106)	(33-105)	(40-112)	(39-106)	(29-107)	(35-104)	(33-107)	
	590	1,698	646	615	634	594	901	1,592	6/58
	(41-108)	(45-120)	(45-111)	(35-116)	(35-99)	(41-107)	(23-107)	(34-108)	
F. majalis.....	1	1	16	-	38	1	-	-	4/57
	(63)	(105)	(29-148)	-	(44-72)	(70)	-	-	
	72	35	18	30	67	17	16	12	5/57
	(62-152)	(44-128)	(32-129)	(65-160)	(37-137)	(60-89)	(73-134)	(72-121)	
	30	35	10	12	19	36	9	39	6/57
	(70-140)	(66-125)	(79-121)	(66-97)	(55-96)	(73-130)	(76-140)	(68-134)	
	179	9	5	5	5	16	5	21	7/57
	(50-155)	(77-115)	(78-131)	(77-138)	(75-119)	(39-133)	(104-140)	(81-109)	

Appendix table 3.--Continued

Species	Station 1	2	3	4	5	6	7	8	Month of collection
F. majalis--Continued....	149 (43-153)	29 (44-153)	11 (49-111)	12 (38-150)	7 (48-153)	8 (53-144)	11 (34-147)	3 (38-128)	8/57
	153 (34-160)	3 (109-139)	9 (36-133)	75 (20-95)	58 (23-147)	84 (21-153)	103 (42-150)	68 (31-145)	9/57
	9 (53-150)	5 (32-62)	23 (45-141)	11 (34-146)	56 (27-151)	98 (40-151)	26 (38-128)	84 (23-156)	10/57
	161 (33-90)	87 (52-114)	24 (42-144)	4 (41-111)	47 (39-74)	75 (33-143)	64 (47-160)	71 (50-154)	11/57
	2 (58-65)	1 (63)	16 (44-103)	4 (40-47)	4 (31-60)	- -	- -	14 (50-146)	12/57
	1 (47)	- -	5 (44-54)	1 (114)	- -	1 (53)	- -	35 (43-149)	1/58
	- -	- -	2 (54-149)	1 (150)	5 (44-133)	8 (47-113)	3 (54-126)	2 (56-66)	3/58
	12 (40-142)	97 (55-143)	9 (48-160)	14 (45-125)	125 (37-150)	67 (30-145)	5 (41-160)	9 (48-115)	4/58
	49 (51-150)	54 (55-150)	3 (64-80)	28 (63-138)	28 (52-148)	50 (48-149)	4 (69-129)	- -	5/58
	246 (65-161)	85 (56-134)	4 (90-137)	77 (69-152)	13 (56-142)	33 (62-140)	13 (74-142)	12 (74-127)	6/58
Lucania parva.....	- -	2 (30-36)	6 (28-30)	- -	12 (34-39)	2 (34-37)	- -	- -	4/57
	- -	19 (26-39)	5 (32-38)	7 (29-40)	4 (25-37)	9 (28-39)	5 (27-34)	1 (28)	5/57
	1 (40)	2 (32-33)	44 (22-41)	29 (24-39)	28 (23-38)	19 (25-35)	13 (28-38)	2 (28-38)	6/57
	13 (23-37)	378 (20-42)	2 (23-25)	1 (25)	1 (24)	2 (22-27)	4 (20-36)	2 (38-41)	7/57
	17 (20-28)	1,200 (15-31)	9 (20-25)	3 (24-28)	2 (29-30)	12 (20-37)	1 (26)	1 (33)	8/57
	4 (26-30)	89 (21-34)	1 (23)	- -	1 (29)	- -	3 (26-39)	22 (27-42)	9/57
	2 (27-30)	29 (19-31)	1 (32)	5 (27-32)	5 (27-30)	3 (25-38)	51 (25-39)	78 (25-40)	10/57
	2 (30)	36 (24-33)	3 (25-35)	3 (32-33)	4 (29-33)	7 (29-40)	6 (29-37)	63 (24-36)	11/57
	- -	36 (21-35)	4 (28-31)	- -	3 (26-40)	24 (23-34)	10 (26-33)	125 (22-37)	12/57
	3 (27-33)	4 (25-32)	1 (28)	- -	1 (26)	3 (29-33)	24 (27-35)	72 (25-39)	1/58
	- -	1 (30)	- -	- -	- -	- -	3 (28-32)	14 (26-36)	2/58
	- -	3 (25-30)	- -	- -	- -	3 (28-33)	2 (31)	24 (26-34)	3/58
	2 (32-37)	73 (23-36)	5 (26-36)	5 (25-35)	22 (27-37)	9 (28-35)	12 (26-36)	16 (25-34)	4/58
	39 (25-38)	134 (25-39)	- -	- -	1 (29)	2 (32-34)	3 (31-40)	- -	5/58
	106 (25-42)	279 (25-44)	1 (35)	9 (24-39)	5 (25-34)	7 (25-38)	13 (25-38)	8 (27-37)	6/58
Gambusia affinis.....	- -	- -	- -	- -	- -	- -	- -	1 (31)	6/57

Appendix table 3.--Continued

Species	Station								Month of collection
	1	2	3	4	5	6	7	8	
Pollachius virens.....	-	1	-	-	-	-	-	-	3/58
	-	(39)	-	-	-	-	-	-	
	2	-	2	-	-	-	-	-	4/58
	(63-70)	-	(49-57)	-	-	-	-	-	
Apeltes quadracus.....	-	15	-	-	-	-	-	-	6/57
	-	(22-32)	-	-	-	-	-	-	
	-	16	-	-	-	-	-	-	7/57
	-	(27-36)	-	-	-	-	-	-	
	-	25	-	-	-	-	-	-	8/57
	-	(24-37)	-	-	-	-	-	-	
	-	1	-	-	-	-	-	-	9/57
	-	(32)	-	-	-	-	-	-	
	1	9	-	-	-	-	-	-	10/57
	(33)	(28-49)	-	-	-	-	-	-	
	-	5	1	1	-	-	-	-	11/57
	-	(39-46)	(34)	(42)	-	-	-	-	
	2	7	3	-	1	-	-	1	12/57
	(40-46)	(36-49)	(37-54)	-	(34)	-	-	(47)	
	-	2	2	-	1	-	-	2	1/58
	-	(34-37)	(34-49)	-	(36)	-	-	(38-44)	
	-	1	-	-	-	1	-	-	2/58
	-	(35)	-	-	-	(35)	-	-	
	1	5	-	-	1	-	-	1	3/58
	(48)	(36-53)	-	-	(37)	-	-	(35)	
	-	6	7	-	2	1	-	1	4/58
	-	(32-49)	(33-52)	-	(33-34)	(47)	-	(43)	
	-	8	-	-	3	1	1	-	5/58
	-	(20-49)	-	-	(22-24)	(24)	(19)	-	
	19	50	2	6	6	4	3	-	6/58
	(22-36)	(25-34)	(29-30)	(23-31)	(28-33)	(22-31)	(25-29)	-	
Gasterosteus aculeatus...	-	4	-	-	2	-	-	-	5/57
	-	(19)	-	-	(20)	-	-	-	
	-	1	-	-	-	-	-	-	5/58
	-	(21)	-	-	-	-	-	-	
Hippocampus erectus.....	-	1	-	-	-	-	-	-	11/57
	-	(70)	-	-	-	-	-	-	
Syngnathus fuscus.....	-	2	-	-	-	-	-	-	6/57
	-	(41-69)	-	-	-	-	-	-	
	-	8	2	-	-	-	-	-	7/57
	-	(89-130)	(70-96)	-	-	-	-	-	
	-	8	4	-	-	-	-	-	8/57
	-	(112-170)	(128-144)	-	-	-	-	-	
	-	3	-	-	-	-	-	-	9/57
	-	(143-198)	-	-	-	-	-	-	
	-	4	2	-	-	-	-	-	10/57
	-	(127-195)	(169-179)	-	-	-	-	-	
	6	-	-	-	-	-	-	-	6/58
	(145-195)	-	-	-	-	-	-	-	
Roccus americanus.....	-	-	-	-	3	1	1	-	4/58
	-	-	-	-	(147-220)	(130)	(92)	-	

Appendix table 3.--Continued

Species	Station								Month of collection
	1	2	3	4	5	6	7	8	
Pomatomus saltatrix.....	-	-	-	-	1	2	-	-	5/57
	-	-	-	-	(39)	(49-64)	-	-	
	-	2	-	-	-	-	-	-	6/57
	-	(83-86)	-	-	-	-	-	-	
	2	1	2	1	2	3	-	-	9/57
	(93-129)	(123)	(98-137)	(81)	(94-107)	(91-104)	-	-	
	3	1	5	3	4	7	-	-	6/58
	(54-62)	(55)	(39-78)	(57-69)	(43-65)	(35-83)	-	-	
Caranx crysos.....	-	-	-	-	-	1	-	-	10/57
	-	-	-	-	-	(135)	-	-	
C. hippos.....	-	1	13	2	3	1	-	-	7/57
	-	(107)	(59-92)	(44-53)	(42-46)	(52)	-	-	
	-	-	-	-	-	-	1	-	9/57
	-	-	-	-	-	-	(131)	-	
	-	-	-	-	-	1	-	-	10/57
	-	-	-	-	-	(60)	-	-	
Decapterus punctatus.....	-	-	1	-	-	-	-	-	7/57
	-	-	(68)	-	-	-	-	-	
Trachinotus falcatus.....	1	-	-	-	-	-	-	-	7/57
	(52)	-	-	-	-	-	-	-	
Eucinostomus argenteus...	-	1	-	-	-	-	-	-	8/57
	-	(32)	-	-	-	-	-	-	
	-	3	-	-	1	-	-	-	9/57
	-	(72-76)	-	-	(77)	-	-	-	
	6	5	-	2	1	-	-	-	10/57
	(44-88)	(51-86)	-	(33-91)	(41)	-	-	-	
Orthopristis chrysopterus.....	2	-	-	-	-	-	-	-	8/57
	(32-35)	-	-	-	-	-	-	-	
	13	-	3	-	-	-	-	-	9/57
	(32-83)	-	(49-62)	-	-	-	-	-	
	2	-	-	-	-	-	-	-	10/57
	(63-76)	-	-	-	-	-	-	-	
Bairdiella chrysura.....	-	68	6	8	54	12	-	-	7/57
	-	(21-69)	(18-42)	(8-32)	(22-58)	(28-62)	-	-	
	1	234	63	162	113	48	51	2	8/57
	(27)	(7-106)	(48-89)	(53-105)	(51-105)	(44-91)	(44-89)	(76-79)	
	1	92	32	117	97	75	83	10	9/57
	(32)	(20-116)	(60-115)	(60-114)	(67-115)	(57-116)	(60-110)	(85-109)	
	1	2	3	2	20	38	27	5	10/57
	(72)	(47-72)	(56-71)	(90-100)	(73-111)	(79-125)	(66-110)	(62-98)	
	-	-	-	-	-	1	-	-	6/58
	-	-	-	-	-	(20)	-	-	
Cynoscion nebulosus.....	-	-	-	-	-	-	1	-	9/57
	-	-	-	-	-	-	(192)	-	
Leiostomus xanthurus.....	-	-	-	-	1	-	1	-	5/57
	-	-	-	-	(48)	-	(63)	-	
	-	-	1	3	3	1	-	-	7/57
	-	-	(195)	(169-184)	(190-200)	(75)	-	-	
	1	-	-	9	1	2	-	-	8/57
	(179)	-	-	(113-200)	(200)	(81-207)	-	-	
	2	3	2	11	5	-	-	-	9/57
	(149-212)	(136-162)	(142-148)	(148-200)	(150-211)	-	-	-	

Appendix table 3.--Continued

Species	Station								Month of collection
	1	2	3	4	5	6	7	8	
Menticirrhus saxatilis...	1	-	-	-	-	-	-	-	7/57
	(122)	-	-	-	-	-	-	-	
	2	-	-	-	-	-	-	-	9/57
	(155-158)	-	-	-	-	-	-	-	
Micropogon undulatus.....	-	-	-	-	1	-	1	-	10/57
	-	-	-	-	(48)	-	(22)	-	
	-	-	-	-	-	1	2	-	11/57
	-	-	-	-	-	(28)	(20-47)	-	
	-	-	-	-	1	1	-	-	12/57
	-	-	-	-	(17)	(26)	-	-	
	-	-	-	-	-	1	-	-	1/58
	-	-	-	-	-	(19)	-	-	
Pogonias cromis.....	-	-	-	-	-	1	-	-	7/57
	-	-	-	-	-	(72)	-	-	
	-	-	1	1	-	-	-	-	8/57
	-	-	(104)	(117)	-	-	-	-	
	1	3	3	1	1	2	-	1	9/57
	(140)	(127-147)	(145-200)	(169)	(115)	(145-155)	-	(171)	
	-	-	-	3	3	8	-	-	10/57
	-	-	-	(182-208)	(164-176)	(149-218)	-	-	
Gobiosoma bosci.....	-	-	-	1	-	-	1	-	4/57
	-	-	-	(33)	-	-	(34)	-	
	-	-	-	2	6	6	6	1	5/57
	-	-	-	(34-45)	(28-52)	(25-45)	(28-45)	(34)	
	1	1	1	-	1	2	2	1	6/57
	(54)	(39)	(39)	-	(56)	(37-52)	(37-43)	(39)	
	-	1	9	60	7	-	-	-	7/57
	-	(54)	(22-44)	(11-32)	(14-28)	-	-	-	
	1	61	31	9	15	10	1	-	8/57
	(26)	(15-42)	(21-36)	(22-37)	(28-36)	(23-40)	(33)	-	
	4	56	40	5	15	7	21	3	9/57
	(36-46)	(20-43)	(15-48)	(27-38)	(17-44)	(21-44)	(20-45)	(27-45)	
	3	32	40	6	5	1	20	2	10/57
	(27-30)	(25-48)	(21-47)	(23-44)	(18-31)	(29)	(24-45)	(26-43)	
	-	2	2	1	8	2	7	-	11/57
	-	(47-53)	(31-36)	(33)	(26-42)	(25-43)	(26-42)	-	
	-	1	4	4	3	3	3	-	12/57
	-	(32)	(30-34)	(24-31)	(27-44)	(25-35)	(26-41)	-	
	-	-	-	-	-	-	-	1	3/58
	-	-	-	-	-	-	-	(30)	
	1	5	2	1	11	14	5	-	4/58
	(21)	(28-54)	(49-52)	(31)	(24-51)	(25-54)	(33-57)	-	
	-	2	4	6	12	2	-	-	5/58
	-	(29-43)	(35-53)	(29-41)	(29-57)	(42-46)	-	-	
	7	3	26	39	19	8	23	9	6/58
	(32-68)	(30-58)	(30-64)	(23-59)	(31-62)	(30-50)	(34-55)	(29-53)	
G. ginsburgi.....	-	-	1	-	-	-	-	-	7/57
	-	-	(10)	-	-	-	-	-	
	-	-	1	-	-	-	-	-	9/57
	-	-	(42)	-	-	-	-	-	
	-	-	1	-	-	-	-	-	12/57
	-	-	(30)	-	-	-	-	-	

Appeadix table 3.--Continued

Species	Station								Month of collectioo
	1	2	3	4	5	6	7	8	
Microgobius thalassinus..	-	-	-	-	3	-	-	-	5/57
	-	-	-	-	(38-39)	-	-	-	
	-	-	-	-	-	4	-	-	6/57
	-	-	-	-	-	(41-55)	-	-	
	-	1	6	30	42	-	-	-	7/57
	-	(29)	(26-46)	(8-47)	(16-48)	-	-	-	
	-	23	74	95	108	65	4	-	8/57
	-	(20-37)	(17-44)	(21-51)	(17-36)	(21-37)	(23-33)	-	
	-	39	45	50	107	91	59	1	9/57
	-	(23-43)	(20-42)	(21-43)	(21-44)	(28-45)	(23-42)	(32)	
	-	5	3	1	5	5	17	1	10/57
	-	(34-44)	(40-42)	(33)	(37-45)	(36-45)	(36-46)	(34)	
	1	-	-	-	6	-	-	-	11/57
	(47)	-	-	-	(27-43)	-	-	-	
	-	-	-	1	4	16	2	-	4/58
	-	-	-	(44)	(44-48)	(38-45)	(40)	-	
	-	-	3	4	3	1	-	-	5/58
	-	-	(38-45)	(40-45)	(45-48)	(46)	-	-	
	-	4	1	34	32	4	2	-	6/58
	-	(40-53)	(40)	(40-51)	(42-51)	(39-50)	(46-48)	-	
Prionotus carolinus.....	-	-	-	-	-	2	-	-	10/57
	-	-	-	-	-	(183-189)	-	-	
P. evolans.....	1	-	-	-	-	-	-	-	8/57
	(51)	-	-	-	-	-	-	-	
Astroscopus guttatus.....	1	-	-	-	-	-	-	-	11/57
	(28)	-	-	-	-	-	-	-	
Chasmodes bosquianus.....	-	2	-	-	-	-	-	-	9/57
	-	(70)	-	-	-	-	-	-	
	-	-	1	-	-	-	-	-	10/57
	-	-	(78)	-	-	-	-	-	
	-	2	-	-	-	-	1	-	12/57
	-	(78-81)	-	-	-	-	(60)	-	
	-	-	-	1	-	-	-	-	3/58
	-	-	-	(83)	-	-	-	-	
Mugil cephalus.....	4	18	-	-	43	55	8	-	4/57
	(29-30)	(29-38)	-	-	(31-38)	(25-41)	(30-39)	-	
	-	-	-	1	14	11	9	6	5/57
	-	-	-	(48)	(33-70)	(6-63)	(46-63)	(58-67)	
	-	1	-	1	1	-	1	4	6/57
	-	(72)	-	(78)	(76)	-	(91)	(66-87)	
	6	3	-	1	1	2	-	-	7/57
	(156-170)	(152-178)	-	(108)	(75)	(123-156)	-	-	
	1	2	1	3	7	2	-	-	8/57
	(177)	(186-189)	(189)	(187-198)	(82-194)	(76-175)	-	-	
	5	1	-	4	5	1	5	1	9/57
	(187-205)	(191)	-	(199-220)	(190-208)	(185)	(189-217)	(192)	
	4	-	22	16	2	2	2	-	10/57
	(202-209)	-	(165-204)	(170-201)	(192-193)	(185-195)	(126)	-	
	-	1	1	-	-	1	2	-	11/57
	-	(233)	(25)	-	-	(24)	(167-197)	-	

Appendix table 3.--Continued

Species	Station								Month of collection
	1	2	3	4	5	6	7	8	
Mugil cephalus--Continued	-	-	2	-	6	5	-	-	12/57
	-	-	(27-28)	-	(25-30)	(26-30)	-	-	
	-	8	4	9	1	-	2	-	1/58
	-	(27-28)	(24-28)	(28-29)	(26)	-	(26-27)	-	
		(232)							
	23	8	201	134	295	159	5	1	4/58
	(27-31)	(28-32)	(24-33)	(26-34)	(26-31)	(27-34)	(29-31)	(29)	
							(215)		
	2	-	251	271	18	77	26	87	5/58
	(26-34)	-	(30-46)	(30-49)	(27-34)	(25-52)	(30-49)	(33-48)	
	-	101	74	320	395	217	55	15	6/58
	-	(55-74)	(55-70)	(43-84)	(30-93)	(37-72)	(39-88)	(33-68)	
M. curema.....	6	-	26	11	1	81	-	-	6/57
	(26-28)	-	(25-32)	(24-30)	(25)	(27-35)	-	-	
	2	12	1	57	44	71	3	1	7/57
	(76-91)	(73-89)	(79)	(51-105)	(20-94)	(26-102)	(65-85)	(41)	
	33	7	41	43	20	25	10	1	8/57
	(80-129)	(100-137)	(86-131)	(97-136)	(82-134)	(85-129)	(89-133)	(109)	
	69	8	20	34	30	8	9	9	9/57
	(110-141)	(115-138)	(117-136)	(112-144)	(100-138)	(85-134)	(112-132)	(100-122)	
	1	18	8	22	10	8	22	6	10/57
	(82)	(95-131)	(69-112)	(84-120)	(91-140)	(80-115)	(72-126)	(92-134)	
	170	-	24	96	80	6	24	60	6/58
	(24-32)	-	(27-36)	(26-33)	(26-34)	(29-31)	(28-34)	(26-35)	
Membras martinica.....	-	3	8	-	-	-	-	-	9/57
	-	(29-46)	(29-45)	-	-	-	-	-	
Menidia beryllina.....	6	144	200	135	537	815	41	-	4/57
	(45-52)	(38-63)	(35-67)	(45-75)	(38-69)	(33-73)	(33-55)	-	
	119	397	647	684	697	787	392	97	5/57
	(40-67)	(39-76)	(38-69)	(39-77)	(39-68)	(37-69)	(34-70)	(39-59)	
	276	361	825	513	673	488	237	575	6/57
	(42-67)	(39-71)	(36-70)	(35-79)	(38-66)	(28-70)	(38-70)	(33-66)	
	71	232	232	57	91	134	79	189	7/57
	(41-65)	(44-89)	(40-70)	(36-66)	(40-58)	(22-72)	(40-64)	(23-53)	
	4	45	52	23	174	143	99	10	8/57
	(50-60)	(40-59)	(45-60)	(44-55)	(40-55)	(40-64)	(40-60)	(40-47)	
	8	33	15	33	500	449	626	612	9/57
	(42-54)	(40-62)	(41-61)	(40-55)	(40-65)	(40-65)	(40-63)	(40-61)	
	35	305	98	332	502	351	288	408	10/57
	(40-46)	(40-64)	(40-62)	(40-62)	(40-65)	(40-60)	(40-70)	(40-68)	
	12	-	4	8	98	134	365	455	11/57
	(40-55)	-	(42-59)	(36-60)	(40-62)	(40-61)	(40-70)	(40-66)	
	-	1	5	8	2	10	5	49	12/57
	-	(51)	(40-44)	(40-53)	(56-57)	(41-63)	(46-56)	(40-60)	
	-	-	1	-	-	2	12	627	1/58
	-	-	(41)	-	-	(40-49)	(40-61)	(40-60)	
	-	-	1	-	1	41	-	42	2/58
	-	-	(43)	-	(59)	(40-70)	-	(40-52)	
	-	-	-	-	1	19	37	900	3/58
	-	-	-	-	(48)	(41-58)	(37-68)	(34-65)	
	6	248	37	274	256	384	221	458	4/58
	(43-50)	(36-66)	(38-61)	(35-61)	(37-68)	(35-68)	(38-72)	(34-60)	

Appendix table 3.--Continued

Species	Station								Month of collection
	1	2	3	4	5	6	7	8	
M. beryllina--Continued..	67 (44-73)	153 (42-69)	65 (46-62)	197 (44-70)	158 (40-65)	270 (39-75)	432 (45-72)	208 (44-68)	5/58
	189 (42-78)	308 (43-69)	289 (40-63)	234 (43-67)	296 (41-76)	346 (41-73)	123 (43-66)	75 (44-62)	6/58
M. menidia.....	39 (49-116)	2 (87-114)	32 (63-109)	21 (59-121)	17 (58-98)	19 (69-105)	- -	- -	4/57
	86 (43-117)	48 (36-109)	20 (85-142)	9 (83-102)	3 (74-104)	3 (94-110)	1 (120)	- -	5/57
	616 (27-118)	27 (36-100)	13 (36-111)	18 (37-50)	4 (39-54)	- -	1 (45)	4 (34-44)	6/57
	324 (40-128)	101 (40-114)	238 (40-115)	150 (40-117)	43 (39-58)	18 (40-72)	9 (40-55)	1 (40)	7/57
	506 (40-122)	213 (40-89)	548 (39-109)	432 (40-87)	210 (40-77)	109 (40-69)	46 (40-70)	1 (47)	8/57
	2,650 (40-109)	817 (40-105)	1,062 (40-117)	1,047 (40-91)	676 (40-118)	382 (40-87)	170 (40-82)	51 (40-108)	9/57
	2,280 (40-119)	698 (40-108)	645 (40-131)	466 (40-108)	678 (36-127)	242 (40-107)	274 (40-104)	18 (41-103)	10/57
	349 (45-108)	71 (57-110)	300 (52-115)	1,165 (53-137)	2,125 (52-180)	982 (47-123)	74 (43-102)	409 (42-103)	11/57
	3 (58-83)	98 (55-100)	22 (58-90)	965 (52-131)	112 (49-100)	919 (50-120)	1,150 (52-129)	- -	12/57
	1 (70)	1 (62)	6 (60-74)	61 (55-103)	151 (58-117)	6 (60-176)	202 (55-104)	4,805 (44-103)	1/58
	- -	- -	- -	- -	- -	19 (45-84)	- -	- -	2/58
	- -	2 (62-63)	1 (106)	27 (48-82)	4 (93-112)	775 (40-106)	125 (48-76)	4 (53-63)	3/58
	71 (58-117)	113 (61-116)	287 (57-120)	407 (51-118)	556 (53-123)	476 (53-123)	155 (54-115)	726 (45-138)	4/58
	20 (51-115)	5 (62-110)	1 (83)	5 (74-110)	- -	1 (65)	- -	- -	5/58
	80 (61-117)	6 (71-101)	5 (78-106)	2 (80-95)	2 (83-93)	1 (100)	- -	- -	6/58
Paralichthys dentatus....	- -	- -	- -	- -	3 (49-60)	1 (95)	1 (84)	- -	5/57
	- -	- -	- -	- -	- -	1 (150)	- -	- -	6/57
	- -	- -	1 (149)	- -	- -	- -	- -	- -	7/57
	1 (143)	4 (145-183)	4 (75-200)	1 (194)	1 (167)	6 (160-255)	- -	- -	8/57
	- -	3 (199-204)	3 (191-273)	2 (165-182)	2 (193-289)	9 (189-220)	1 (198)	- -	9/57
	2 (206-235)	1 (225)	- -	1 (182)	3 (156-212)	2 (226-258)	4 (182-245)	- -	10/57
	- -	- -	- -	1 (208)	- -	- -	- -	- -	11/57
	- -	- -	- -	1 (169)	5 (23-30) (169)	3 (25-32)	- -	- -	4/58
	- -	- -	- -	2 (54-67)	3 (56-65)	- -	- -	- -	5/58

Appendix table 3.--Continued

Species	Station								Month of collection
	1	2	3	4	5	6	7	8	
Paralichthys dentatus--Continued	2 (68-98)	- -	3 (71-103)	6 (78-108)	1 (107)	- -	- -	- -	6/58
Pseudopleuronectes americanus	2 (78-86)	- -	2 (67-81)	- -	- -	- -	- -	- -	7/57
	33 (75-121)	- -	3 (84-114)	- -	- -	- -	- -	- -	8/57
	24 (65-118)	3 (99-116)	11 (70-119)	- -	1 (86)	- -	- -	- -	9/57
	22 (44-136)	4 (101-118)	5 (92-131)	1 (100)	- -	- -	- -	- -	10/57
	3 (140-160)	- -	3 (142-174)	- -	- -	- -	- -	- -	11/57
	- -	1 (148)	1 (177)	1 (143)	- -	- -	- -	- -	12/57
	- -	- -	2 (161-168)	- -	- -	- -	- -	- -	1/58
	- -	- -	- -	1 (140)	- -	1 (171)	- -	- -	3/58
	1 (200)	1 (189)	3 (155-179)	1 (173)	- -	- -	- -	- -	4/58
	- -	- -	5 (50-54)	4 (42-52)	- -	- -	- -	- -	5/58
	25 (65-80)	1 (62)	26 (44-76)	1 (45)	4 (44-65)	- -	- -	- -	6/58
Trinectes maculatus	- -	- -	- -	- -	- -	- -	- -	1 (47)	6/57
	- -	- -	- -	- -	1 (57)	- -	- -	- -	10/57
Symphurus plagiusa	- -	- -	1 (58)	- -	- -	- -	- -	- -	9/57
Sphaeroides maculatus	1 (152)	- -	- -	- -	- -	- -	- -	- -	7/57
	1 (82)	- -	- -	- -	- -	- -	- -	- -	8/57
	3 (170-200)	- -	- -	- -	- -	- -	- -	- -	6/58
Opsanus tau	- -	- -	- -	1 (250)	1 (113)	- -	- -	- -	5/57
	- -	- -	- -	- -	- -	1 (73)	- -	- -	6/57
	2 (31-38)	18 (33-58)	4 (36-55)	3 (43-54)	- -	- -	- -	- -	7/57
	4 (53-56)	53 (37-300)	13 (43-173)	19 (45-124)	4 (54-64)	- -	- -	- -	8/57
	8 (52-188)	7 (60-103)	22 (59-195)	16 (38-307)	9 (62-76)	4 (70-74)	5 (69-104)	- -	9/57
	2 (61-63)	1 (300)	4 (71-83)	2 (58-65)	4 (70-83)	- -	- -	- -	10/57
	- -	1 (280)	- -	- -	- -	- -	- -	- -	4/58
	- -	2 (110-225)	1 (225)	- -	- -	1 (87)	- -	- -	6/58

Created in 1849, the Department of the Interior--a department of conservation--is concerned with the management, conservation, and development of the Nation's water, fish, wildlife, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

As the Nation's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that park and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States--now and in the future.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
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